TAMPERE UNIVERSITY OF TECHNOLOGY

Department of Signal Processing

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Microsoft Ecosystem

Master of Science Thesis

Examiner: Professor Irek Defée Examiner and Subject were approved in the Faculty of Computing and Electrical Engineering Council meeting on 04-04-2012

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ACKNOWLEDGMENTS

This thesis work is done in 2011-2012 in the Department of Signal Processing, Tampere University of Technology.

I would like to thank Professor Irek Defée for considering me worth for this work and his continuous guiding and supporting during the thesis work.

I would like to show my gratitude to my parents for raising me up and supporting me through all these years.

Tampere, May 2012

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ABSTRACT

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Mobile technology landscape has changed drastically in recent times. The change is due to the merging of mobile systems with the Internet and the Web. Mobile devices functions expanded much beyond their traditional use and became part of bigger systems. These systems have been given name ecosystems by using analogy with biological ecosystems. Mobile ecosystems are characterized by integration of devices, applications and services creating a dynamic, living business system. Ecosystem attracts large number of independent application and service developers who can develop and sell their products using application stores. Ecosystem owners provide strategic tools and services which are quickly evolving. This creates very strong drive for innovation in the ecosystem and attracts huge number of users who are willing to pay for new applications and services. Ecosystem owners get huge profits from advertising and profiling the users. This makes mobile ecosystem alive and expanding. There are two existing mobile ecosystems created by Apple and Google which became huge success. This has undermined position of Nokia in the mobile world and challenged the role of Microsoft in the information technology world. In this thesis we analyze efforts of Microsoft to create another mobile ecosystem in which Nokia could play major role. Apple and Google ecosystems are described and evaluated in detail. Components of Microsoft platform are described next and compared with Apple and Google. Challenges for Microsoft to create its own ecosystem are analyzed and conclusions are formulated.

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TERMS AND ABBREVIATIONS

ME	Microsoft Ecosystem
AE	Apple Ecosystem
GE	Google Ecosystem
VS	Visual Studio
AS	Application Store
WLM	Windows Live Market
GP	Google Play
MST	Microsoft System Tools
GPS	Global Positioning System
UI	User Interface
LK	Linux Kernel
WM	Windows Mobile
WXL	Windows Xbox Live
XLM	Xbox Live Marketplace
SF	Silverlight Framework

1 INTRODUCTION

Ecosystem is a term which originates from biology. From biological point of view any system of living organisms which is able to continuously live, reproduce, adapt, grow and develop by interacting with non-living matter creates the structure of an ecosystem. The ecosystem is self-sustained and closed with supply of energy coming eventually from the non-living components like water, soil, sunlight, air. The notion of ecosystem has been recently expanding to cover other type of systems which exhibit kind of sustained life on their own. For example a group of people living in same geographical area, together with its environment working as a functional unit can also be called an ecosystem since it is the relationships between living resources, habitats and residents which create the system. Economy of a country can be called an economic ecosystem.

There is also a talk about business ecosystem, digital ecosystem, information technology ecosystem. The business ecosystem refers to an economic community which is producing products or services, providing them to customers through suppliers, as a result there is created a strong network among them based on the exchange of goods, services and money. Digital ecosystem, is a distributed digital infrastructure, aimed to create a digital environment in which large variety of application and services is running. The interrelationship system among organizations which are producing IT products and providing services is called Information Technology ecosystem.

Recently the concept of ecosystem has been applied to the infrastructure emerging from the development of mobile devices. The mobile ecosystem is an outgrowth from the evolution of cellular telephones into the Internet devices with host of multimedia and Web applications and services. Due to this development mobile devices are now forming a part of an ecosystem and its organization, the scope of applications and services which it offers is even more important for consumers than the devices themselves. Of courses consumers select devices based on their usability and performance but as the devices become good-enough for all kind of usage, users decide to choose them based on their ecosystem. From this point of view one can say that the devices become a small part of the ecosystem, without the ecosystem even the best device is not attractive to the users and will not survive. This change in the role of mobile devices has critical impact on the traditional manufactures like Nokia. Devices which they produce must be a part of an ecosystem, otherwise they have little value even if technically they may be very good.

The mobile world is at present being divided into two giant ecosystems. One is created by Apple and another by Google. From the device point of view these ecosystems are in fact not limited to mobile, they are gradually expanding to tablets,

laptops, desktops and televisions. This challenges the position of not only Nokia but also Microsoft which for many years was a leader in the PC-based operating system and applications. To survive in the ecosystems world Nokia and Microsoft must be present there. Being the major competitor of Apple and Google Microsoft has no other choice than creating its own ecosystem. This potential ecosystem is called in this thesis the Microsoft Ecosystem. However, as indicated above, the new ecosystems are essentially based on mobile devices where Microsoft has no presence. Here there is a role for Nokia which has for many years been the "Microsoft" of the mobile devices but lost its position due to inability to create its own mobile ecosystem. Microsoft and Nokia have thus the same challenge in the creation of an ecosystem and have complementary positions and skills. It is logical they joined together to create a common mobile platform for the third ecosystem. This platform will be based on the Microsoft Windows Phone OS and Nokia mobile hardware with the critical ecosystem infrastructures, applications and services developed by both companies. It seems however that the role of the Microsoft in the developing, establishing and potential success of the third ecosystem will be much bigger than Nokia. Microsoft will supply all critical components while Nokia may provide its own applications and services, perhaps trying to make its own 'sub-ecosystem'.

The strategy of Microsoft and Nokia aiming for the creation of the third mobile ecosystem is facing enormous challenges against the giant and established ecosystems from Apple and Google. The Apple ecosystem is strictly proprietary both from the hardware and software point of view, based on a minimal set of finely perfected user devices and very wide choice of applications and services. Apple ecosystem includes full range of devices: iPhone, iPad, iMac, iPod, desktops, and Apple TV. While the total market share of Apple users is not high, Apple has an extremely high brand loyalty and very devoted users, in a sense this is a "tribal" ecosystem. The Google ecosystem is in many respects opposite to Apple. It is based on the open software platform called Android. This platform, based on Linux, Java and open UI is highly adaptable to any hardware and can be used by anybody. Due to its features the Android platform has been adopted by all mobile hardware manufacturers except Nokia and it is now leader of the market in terms of size. Google is keeping major role in the ecosystem by offering essential infrastructure services and applications like search engines, mail, maps, social media, application store, etc. But others, especially major mobile device manufacturers like Samsung are trying to provide their own applications and services, perhaps trying to establish their own sub-ecosystems.

It is also important to note the economics of mobile ecosystems, how they are financed and the money and profits flows. The ecosystems have great financial benefits for their owners, especially when comparing to mobile device hardware manufacturers. This is due to the fact that owners offer major service and applications

from which they get money. Equally, or maybe even more important, is that the owners have user databases and can track user behaviors which provide very valuable tools for marketing and advertising. Owners of the ecosystems can thus secure constant revenue flows from users while device manufacturers only get money once when they sell a device. This makes market valuations of the ecosystems owners very high. This shows that Microsoft and Nokia are companies which are in danger of marginalization by the expansion of the two existing ecosystems. Microsoft has a lot of components and skills which can be used for building and ecosystem and has to be act quickly to succeed.

This thesis aims for the analysis of the mobile ecosystems and Microsoft position in building the third ecosystem. In the thesis we first describe the concept of ecosystem and its components. Next we analyze in detail and compare the Apple and Google ecosystems. Subsequently, various Microsoft software, hardware and infrastructure components are described and analyzed from the point of their place in building the third ecosystem. Finally, we compare the potential of Microsoft and conclude about its chances to succeed in building the third ecosystem with Nokia.

2 MOBILE ECOSYSTEMS

Mobile ecosystems are systems based on devices, networks, infrastructure, applications and services. These systems are very dynamic due to the constant build up of hardware and software components and innovation in services and applications. Ecosystem requires tight integration of the components and forming community of users and developers which creates business environment supporting creative expansion. In this chapter architecture and components of ecosystem are presented.

2.1 ECOSYSTEM ARCHITECTURE AND COMPONENTS

Networked information technology is the nervous system of modern society. This technology allows access to information, distribution of information and communication for everybody at very low cost. Mobile communication allows instant handling of information in any place at any time. Mobile devices are enablers of mobile ecosystems. However, the devices itself are not sufficient for the creation of mobile ecosystems. Reason for this is that an ecosystem requires environment for circulation of applications, services and money on which business can thrive. An ecosystem forms thus an entity composed of various components. Components are important but their integration is critical for making the ecosystem. General model of architecture of mobile ecosystem is shown in Fig. 2.1.1. In this model there are two basic parts: Infrastructural Components part and Applications and Services part. From the user point of view the Applications and Services part is what is visible and accessible on a device. Many of the basic applications and services are depending on the ecosystem infrastructure.

A service which is absolutely critical for the existence and development of an ecosystem service is Application Store, AppStore in short. For the user it is just an application through which the user can access, buy (if it is not free) and download new applications. For the ecosystem operator or partner the AppStore requires infrastructure based on servers, web interfaces, a system for the evaluation of application and billing. Some applications are financed by advertising which requires a system for placement of ads. Complete AppStore system is critical since it provides huge dynamism for innovation, attracts consumers and developers which creates new business and revenue flows. Attraction for consumers is instant access to new applications which can be selected from huge variety and serve any need. Attraction for developers is global, instant access to users at relatively low cost, there is no need for investment to get access to the market. There is thus a huge business opportunity for anybody who might have good idea. But the AppStore in an ecosystem will thrive only there is sufficiently large pool of users and developers.

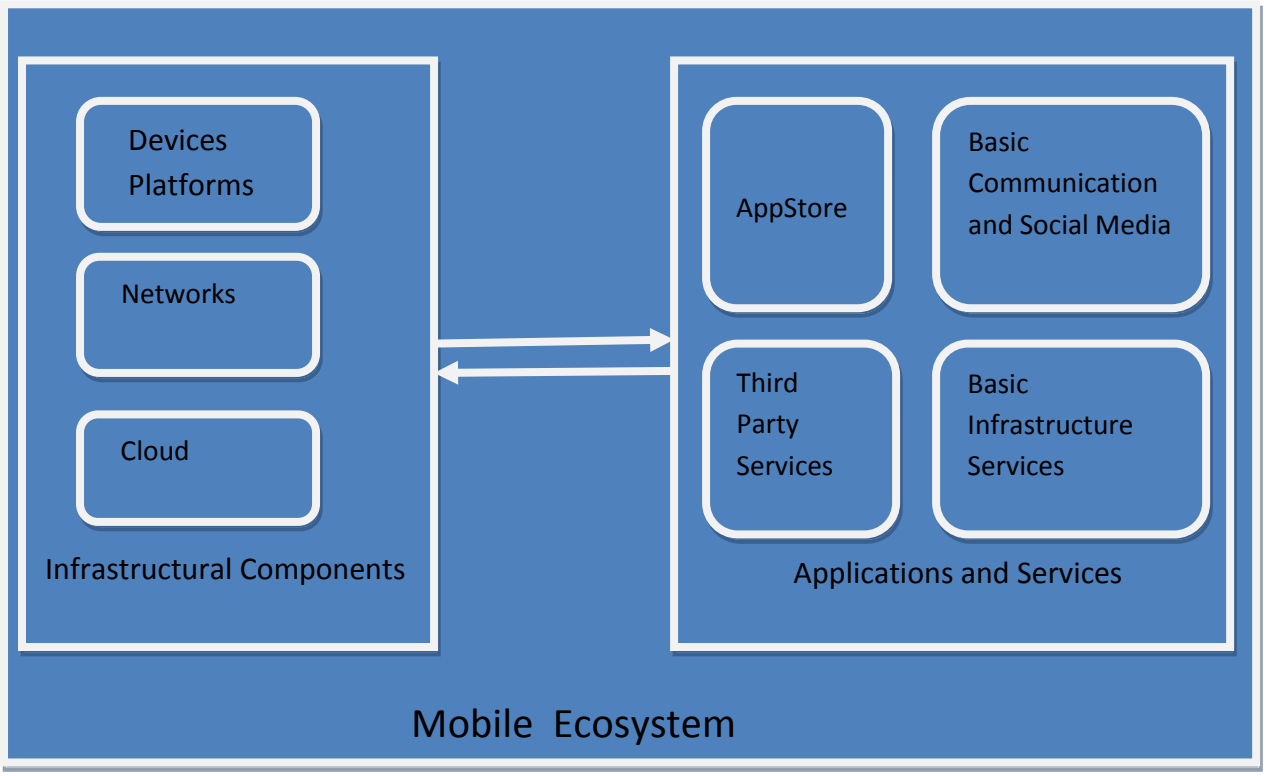

Fig. 2.1.1 General architecture of mobile ecosystem

Cloud is another basic infrastructural service which has critical value for users. Cloud provides external storage space for user information together with syncing. External storage space is valuable since it frees the user own local storage and protects information against loss. For the ecosystem owner cloud provides opportunity for tracking and profiling behavior of users. Syncing allows the cloud information to be accessible from any networked device the user may have. Thus the user does not need to copy information between the different devices, information can be easily shared with other users and it can be preserved in secure way which is very convenient. For the ecosystem owner or partner the cloud system obviously requires big investment in data centers and networks able to store information from large number of users. But this investment is paying-off well since it is tying-up users to the ecosystem. Due to this, some storage space in the cloud is offered for free, additional storage can be bought by users, which provides constant revenue flow. It is also very important to realize that owner of the ecosystem has access to the data stored and information about its usage. This may provide a lot of data on consumer behavior which has great value for marketing and advertising. The cloud service can thus attract business and provide constant flow of revenue which is necessary for the ecosystem.

There are many other basic infrastructure services which are important from the user point of view and for running the ecosystem. Map and navigation services are convenient for the user, from the owner point of view they are basis for providing information about location of businesses. Communication services and social media are necessary for users and they also provide precious information for the ecosystem owners about users behaviors.

The role of devices and software platforms in the ecosystem is critical from the user point of view since the device feel and look is what the user really sees and feels. However this is not decisive anymore since devices and user interfaces became very similar. From this, one can conclude that the ecosystem properties as a whole will be most important for the users and major attraction to the ecosystems. We shall now overview two existing ecosystems by Google and Apple.

2.2 GOOGLE ECOSYSTEM

Google ecosystem started with the release of open device software platform called Android. Android is based on the Linux kernel, Java virtual machine and user interface. Android is basically an open platform and can be used by any device manufacturer. What greatly helped Google in the creation of its ecosystem is the fact that before launching Android it already had many infrastructure components, services and applications. Google thus managed to make in a relatively short time a full ecosystem depicted in Fig. 2.2.1 according to the general architecture from Fig. 2.1.

The critical AppStore service called Google Play is very well established, with hundreds of thousands of applications and large community of developers. Google Play is an online application store and market place where users are able to access movies, music, apps, games, books, etc., from the web and the Play store for android devices. Developers also can host their applications and games to the marketplace where consumers can download and use the applications and games. Using Google Play users can purchase and enjoy usability of application instantly without any hassle and need for syncing. Play contains free application as well as paid applications. The Play Store App will allow user to download movies, music, books, and applications. The Play Store was introduced in March 2012 which merged with its predecessors Android Market and Google Music services. This Google Appstore is now the biggest mobile applications development platform.

Among the most valuable assets of Google is its search engine which is the most widespread and used service of its type. Behind the search engine there is a global network of Google data centers which process queries and collect data about users. For users, Google search engine may look free to use but the company has sophisticated system of advertising and marketing based on the search engine which brings very substantial revenues.

Google Maps is a web based application services which provides information regarding location of different places, distances by foot, car, bicycle, etc., and route plans to get direction from one place to another which cover large parts of the world. Te Google Maps services can be integrated with third party service via Google Maps API. It provides high resolution satellite images for world urban areas. One of the latest versions of Google Maps with navigation service includes the features like detailed maps with 3D buildings; voice guided turn-by-turn GPS navigation, driving, public transport, biking and walking directions; live traffic information to avoid congestion; local search and business reviews; Google maps street view etc.

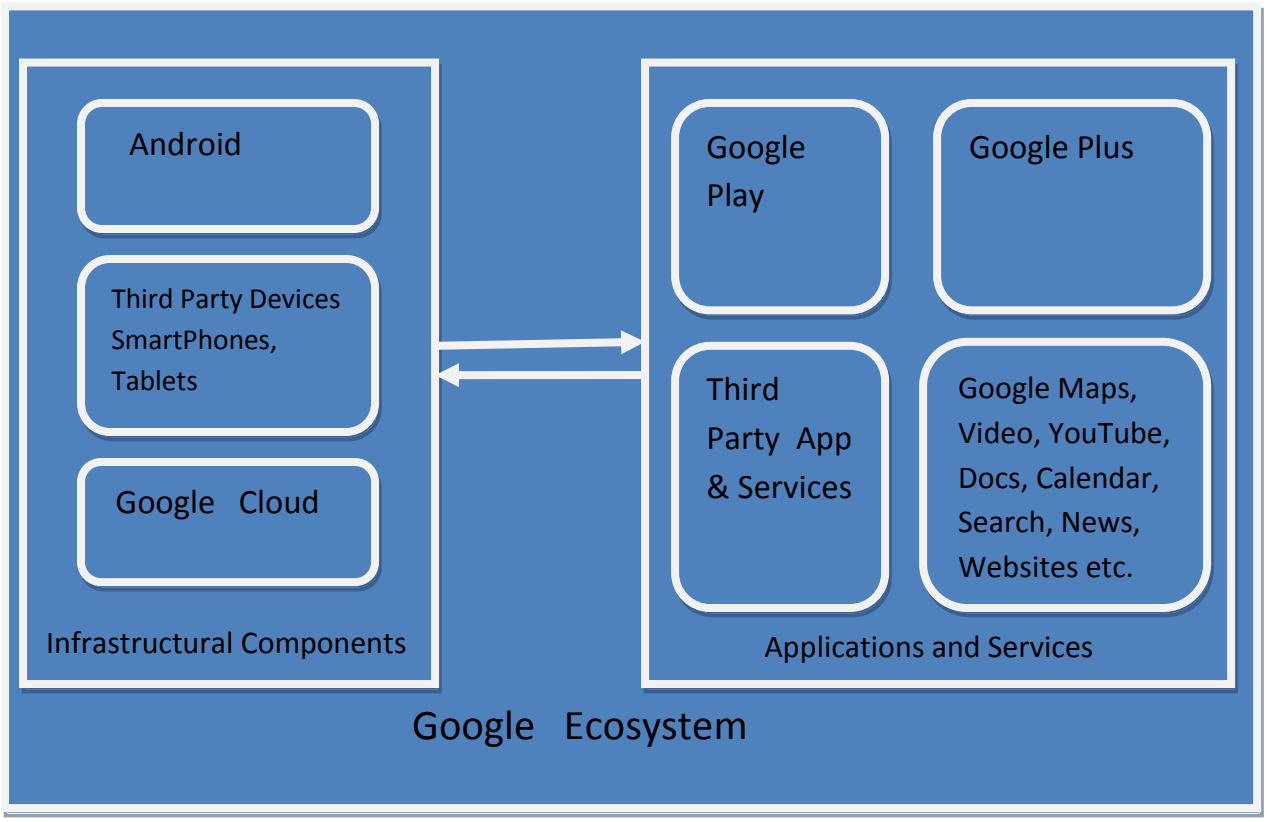

Fig. 2.2.1 Architecture of Google Ecosystem

Comprehensive set of communications and social media service are provided by Google Plus, Google Talk, Google Alerts, Google SMS, Google Calendar. This is overall contributing in both social and communication arena simultaneously. It includes features like create Circles, Stream, Messenger, Instant Upload, Sparks, Games, Data Liberation etc. People can create circles and share particular post to that circle members. Other people can see the list of peoples in a user's circle but they cannot view the names of circles, by applying privacy policy users can hide information as well. Hangouts are the places which provide facility for group video chat. Using messenger feature users are able to chat with their circle members from Android, iPhone and SMS devices which provides the facility of instant communication, users can also share photos with group members. Instant upload features is device specific which stores photos and videos in a private album to share later on. Google Plus also provides the facility of gaming which is located under the gaming tab. Using the Data Liberation feature users can download another users content from Google Plus. With this broad array of applications users can satisfy almost any social communication need and thus will be tied with very many links to the Google ecosystem.

Google has full infrastructure for the global cloud and it can offer large number cloud of applications. The Google cloud is integrated with applications like Google Docs. Gmail is Google webmail service which offers free 7GB storage now and allows users to put attachments files up to 25MB for individual message. iGoogle is personalized Google page which allow to add news, photos, weather, stuff etc to user homepage which contains Google search box at the top and any number of gadgets will be shown below selected by user. Gadgets provide access to different activities and gather information from different sources of the web. Some of the handy features of Gadgets are like View latest Gmail messages; Read headlines from Google News; check out weather forecasts, movie showtimes; bookmarks to favorite sites for quick access; design own gadgets based on user choice. Google alerts provide latest updates results based on user query where user can select different types of options like Result Type, how often he wants to receive results, how many results user want to see and also which email address the results will be delivered. Usability of alert system which requires sign in procedure, type of information you requested in your local place etc. Among some handy features of Google Alerts are monitoring developing news story, getting latest updates of celebrity or event, keeping tab of user favorite sports teams.

Google also owns YouTube which is in fact a media company with user created content. YouTube may have big potential for the future if professional media companies will start using it. Google wants to accelerate this development by introducing Google TV, a platform for new type of Internet-based television.

User accesses this large portfolio of applications and services via device based on Android, or precisely speaking by the Android user interface. The user interface is thus absolutely critical and Google is constantly developing new improved versions of the interface. Android user interface is typical for the present devices, based on touch with quickly accessible widgets as shown in Fig. 2.2.2

Fig. 2.2.2 Android User Interface

Device manufacturers can also implemented their own user interface for Android. This gives them possibility for more innovation and it contributes to faster development of the Android usability.

Below the user interface layer Android provides standard modern platform which has distinctive feature of being highly adaptable to different types of devices and hardware. Android architecture as shown in Fig. 2.2.3 consists of the Linux kernel, middleware libraries, APIs, Application Framework, Application software running on Application Framework where this Application Framework includes Java compatible libraries which are based on Apache Harmony. Regarding the hardware platform Android covers ARM architecture, and Intel x86. Android support lots of features and specifications among them some major ones are mentioned below.

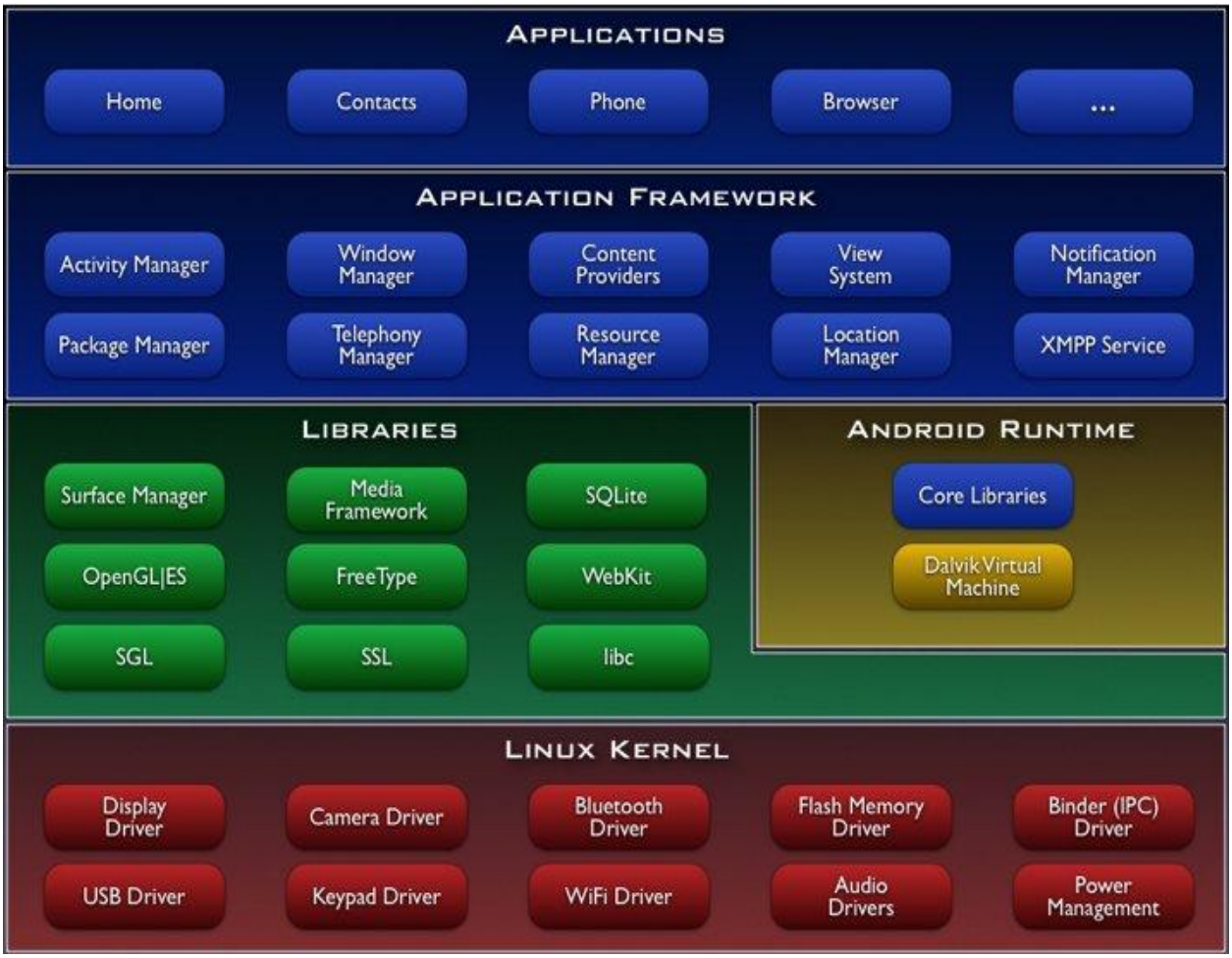

Fig. 2.2.3 Architecture Diagram of Android Platform

Architecture of Android platform could be considered as four major parts which are Linux kernel, Libraries, Runtime, and Application Framework where each part is responsible for particular types of services and tasks. As a result it is little bit easier to handle different types of functionality without any hassle. Application Framework is responsible for different types of core applications and services like SMS programs, email client, calendar, maps, browser, contacts etc. where all of the applications are written in Java. Building an application with rich and extensible views where all types of modern contents like lists, grid, text boxes, and buttons could be included is supported by Application Framework. Application Framework also includes service components like Activity Manger, Window Manager, View System, Resource Manger, Telephony Manager XMPP Service, etc.

Another core part of Android platform is Libraries which includes set of C/C++ libraries used by different components of Android system. Among them Surface Manager, Media Libraries, FreeType, SQLite, SGL, Webkit, Open GL ES etc. are core libraries where each libraries is responsible for particular task. Surface manager

manage access to display subsystem and composite 2D and 3D graphics layers from multiple applications. Media libraries are responsible many popular audio and video formats as well as image files. Freetype is doing bitmap and vector rendering. SQLite is a powerful relational database available for all applications.

Runtime is an important part of Android platform which is used to run applications where each application runs on its process, with its own instance of the Java Dalvik virtual machine. A device can run multiple VMs efficiency, Dalvik VMs executes files in .dex(Dalvik Executable) format which is optimized so that it takes minimum memory. For threading and low level memory management functionality Dalvik VM relies on Linux Kernel.

Linux Kernel is a vital part of Android platform which is responsible core functionality. Core system services like security, memory management, process management, network stack, driver model etc. are handling by Linux kernel and Android relies on it for these major important features. It support features like Display Driver, Camera Driver, Bluetooth Driver, Flash memory Driver, USB Driver, Wi-Fi Driver, Power Management, Audio Drivers etc. Kernel is also working as abstract layer between hardware and software stack.

Looking towards next and present generation Android supports all types of connectivity like GSM, CDMA, Wi-Fi, LTE, NFC, WiMAX, UMTS etc. It also support cloud to device messaging to send data from server to applications on android devices. Android support multiple languages. Media supports include audio and video format like H.263, H.264, MPEG-4 SP, AMR, AMR-WB, AAC, HE-AAC, MP3, MIDI, WAV, JPEG, PNG, GIF, BMP etc. beside this it also supports streaming media like RTP or RTSP(3GPP PSS, ISMA), RTMP(Adobe Flash Streaming), HTTP dynamic streaming support through Flash plug-in.

Overall the Google mobile ecosystem has incredible scope of applications and services. Its installed base is huge and becomes dominant in the market in terms of size. Important aspect of this is ecosystem is its openness which attracts many hardware manufacturers and application developers. Android is a highly adaptable user platform which speeds up hardware and software evolution.

2.3 APPLE ECOSYSTEM

Apple ecosystem started when the company, which had long tradition in the PC area being a minor competitor to Microsoft, launched its iPhone device. This was very surprising as the company has not been specialized in mobile phones before. But the iPhone device and its user interface were highly innovative which, despite a high price, attracted significant number of users, initially in the US. Having the iPhone product Apple immediately started using it as the Internet device launching new services and applications. One can say that Apple became the creator of first mobile ecosystem by opening AppStore and attracting huge number of application developers. In effect Apple created full-scale ecosystem as shown in Fig. 2.3.1.

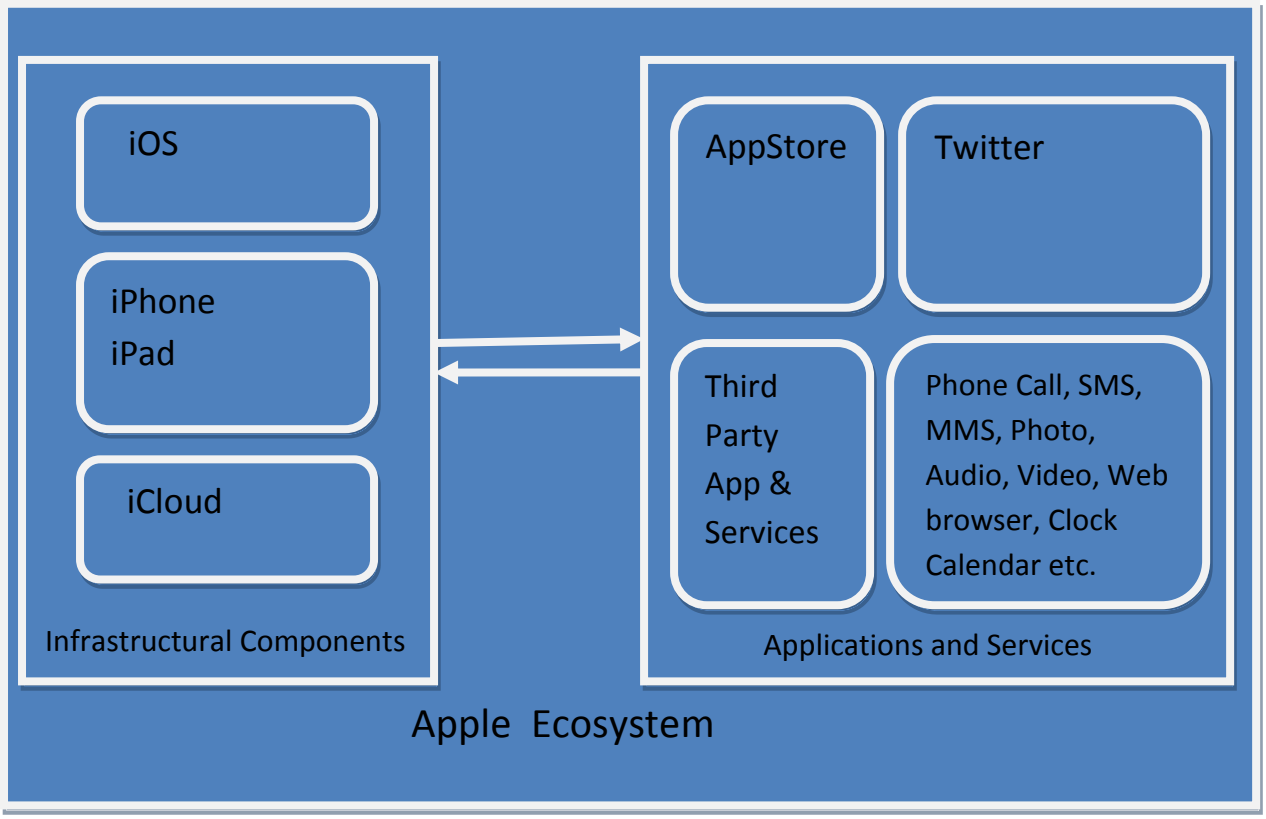

Fig. 2.3.1 Architecture of Apple Ecosystem

Having long background in operating systems and PC area, Apple developed the iPhone platform based on its proprietary Mac OS by scaling it down, this resulted in the iOS. iOS is used currently on all portable devices by Apple, iPhone, iPod, iPad, Apple TV.

Basic infrastructure services are AppStore and iCloud. AppStore has hundreds of thousands of applications, it is also integrated with Apple iTunes music store. Both operations are highly profitable for Apple. Users can buy and download applications; developers can implement and host applications to the application store, which

provides benefits users, developers and owners. The iCloud is another vital component of Apple ecosystem where users can stores music, documents, photos etc. and easy manage and syncing contents to different types of devices automatically. iCloud keeps email, calendar, contact update across devices without any need for manual management and syncing. With the help of iCloud computing users get advantages like faster access of information, adopt new features and functionality with less effort. Users do not need to worry about their information hacking as Apple is maintaining special security to protect information and keep privacy. With the new iCloud service user will get the purchased music iTunes to their other Apple devices automatically without syncing. Apple claims that currently the service has well over 100 million users.

Apple has launched iMessage service for all iOS 5 users. Users can send unlimited text messages from iPad, iPod, iPhone to anyone using those devices through Wi-Fi or 3G connection. iMessage support is integrated with message application so users will be able to send text, photos, video, locations and contacts and can track message using delivery receipts. Changing device during conversation will show user where user left off on another device will provides an excellent experience of live messaging. The coming new version of the iOS 5 will organize users magazine and newspaper apps subscription in Newsstand folder which helps to access favorite papers and publications in a faster way. There will be a new place only for Newspaper and magazine subscriptions in App Store which can be accessed from Newsstand directly. New purchased stuff will go to Newsstand folder directory and when new contents will be available Newsstand updates it automatically gives the test of having newspaper in front door of your home. Reminder service is not limited to remind users anymore; besides user can choose location and due date together with event selection. When users pull to the particular location reminder will give an alert to user regarding corresponding event. iOS is providing one of the best gaming platform service which included new feature to add gaming face through a profile picture by which users can play games with the known person based on recommendations. iOS 5 includes Airplay service which provides facility to stream wirelessly and securely to HDTV via Apple TV. Audience can see exactly what users are doing with Apple devices including all types of rotation, zoom in and zoom out.

Social Media application like Twitter enrich Apple media community more enriched. Basically Apple is not the owner of Twitter but to keep contribution in social media Apple integrated this social media into their iOS operating system. Users can add location to any tweet; it does not affect which apps users are using. Users can share photos, videos easily without any complexity. It is not even ends here users can make groups post by topic and type. After choosing other Twitter users their updates will be appeared in someone's Twitter main page. Users also can send SMS and communicate

with their friends though this service whole over the world. Twitter integration and its entire features enriched social media and communication component of Apple ecosystem.

iPhone is the main device of Apple ecosystem but the iPad is also spreading and most likely iPad users also own the iPhone. Apple initiated the nowadays common look of user interface with touch and widgets as shown in Fig 2.3.2. Apple is still very innovative regarding the user interface, its latest software provides speech recognition application Siri which is in fact interface to an artificial intelligence system capable of answering intelligent queries. Apple has been also first to introduce high-density, so called retina displays which improve readability.

The philosophy of Apple is exclusive and total ownership of the platform. This means strategic software of Apple is proprietary and Apple also tries to make the hardware proprietary as much as possible. Nowadays this includes even the design of own mobile processors and ordering displays built to own specifications. Another unique feature of Apple is limited number of devices which it offers, a single model of iPhone and iPad at a time. This is in stark contrast to other companies but it works for Apple since its products are made to very high standards and finely tuned. Apple can be thus considered as a company which makes luxury, ‘handcrafted’ products.

Fig.2.3.2 User Interface of iOS

Architecture of the iOS could be considered as four abstraction layers like Core OS, Core Services, Media and Cocoa Touch. The layered architecture of iOS is shown in Fig. 2.3.3. Cocoa Touch is a User Interface framework responsible for building software programs to run in different Apple devices like iPhone, iPad etc. Cocoa Touch Layer includes features like multitasking, touch based input, push notifications, document support, storyboards, printing, data protection, gestures recognizers, file sharing support, peer-to-peer services, external display support etc. Many frameworks inside Cocoa Touch Layer also include view controller to represent standard interface. Inside frameworks support it includes Address Book UI Framework, Event Kit UI Framework, Game Kit UI Framework, iAd Framework, Map Kit Framework, Message UI Framework, Twitter Framework, UIKit Framework etc.

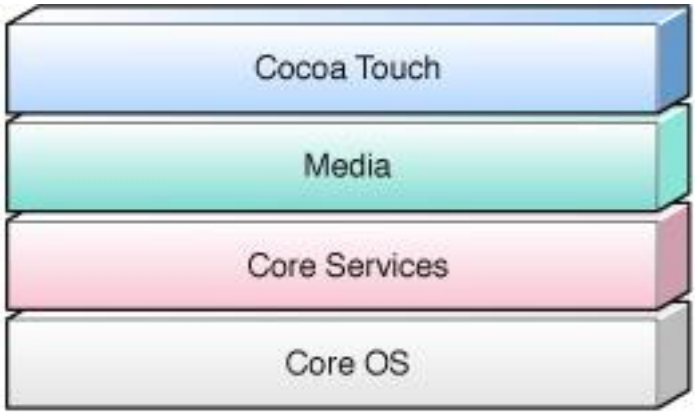

Fig.2.3.3 Architecture of iOS Layers

Media Layer is basically designed to support audio, video, graphics technologies looking towards creating best multimedia experiences in mobile devices. High graphics quality support is a core part of iOS applications. Graphics technologies in Media Layer will help users to use core graphics to handle two dimensional vector and image based rendering, core animation, Core image support to manipulate video and still images, OpenGL ES and GLKit for 2D and 3D rendering, Core text for smooth and sophisticated text layout etc. Audio and Video technologies are designed to taste users the best experience of audio and video. iOS supports audio formats like AAC, Apple Lossless(ALAC), A-law, IMA/ADPCM(IMA4), Linear PCM, DVI/Intel IMA ADPCM, Microsoft GSM 6.10, AES3-2003. Audio framework inside iOS provides sophisticated interface to play and record audio contents. Among video formats iOS cover H.264 video, MPEG-4 which includes .mov, .3gp, .mp4, .m4v file formats etc.

The Core Service Layer contains the services basically used by all applications. It covers high level features like iCloud Storage, Automatic reference counting, SQLite, In-App Purchase, XML support etc. This layer also supports framework like Accounts Framework, Address Book Framework, CFNetwork Framework, Core Data Framework, Core Foundation Framework, Core Location Framework, Core Telephony Framework, Newsstand Kit Framework etc.

Core OS Layer covers basic core level features like Accelerate Framework, Bluetooth Framework, Security Framework, Security Service Framework, System control where system level forms with drivers, kernel environment, and low-level UNIX interfaces of OS. iOS supports two types of application development like Native applications and Web applications.

LifeStyle Integration is another part of Apple ecosystem which basically helps the life style of user through different types of technologies which makes life much easier. User can send message, set reminders, search for information like restaurants location,

getting directions etc. One of key components of this is the Speech Interpretation and Recognition Interface (SiRi) technology, which works based on voice command and is able to respond to intelligent queries.

After introducing iPhone inside their ecosystem, Apple kept its expansion in the connectivity arena. Apple has now a palette of hardware devices like iPhone, iPad, iPod, iTV. For music entertainment in they introduced different models of iPod aiming to gain various customer markets, so that customers get options to choose depending on their demand and requirements. Some of them are iPod Shuffle, iPod Nano, iPod Classic, iPod Touch (Fig. 2.3.3).

Fig. 2.3.4 Apple iPods series iPod Shuffle, iPod Nano, iPod Classic, iPod Touch

Apple also introduced iPad which is one of the most pleasant media tablets (Fig. 2.3.5), Usign iPad users are able to download and read newspapers, magazines, e-books, watch movies, video clips, photos etc.

Fig 2.3.5 Apple iPad, media tablet

Another ecosystem product is Apple TV, could is an interactive iTV box introduced to bridge with the contents covering in iTunes with high definition television. Using Wi-Fi or wired network this device is connected to the user TV.

All products and services available in Apple ecosystem makes large developer community where peoples from different categories is getting opportunity to utilize proper benefits of it. The following figure is a representation of Apple ecosystem products that is available in market [2].

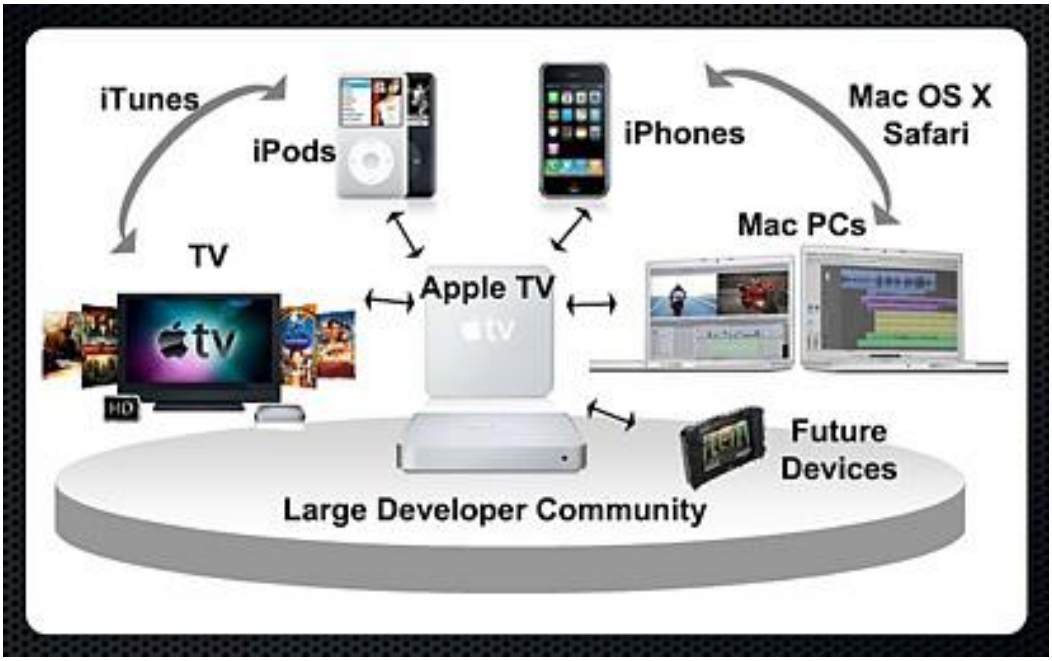

Fig. 2.3.6 Apple Ecosystem Products

In computer technology Apple has designed and developed different products which have brand names as Mac

i. Mac Mini
ii. iMac
iii. Mac Pro
iv. MacBook Pro
v. MacBook Air

MacBook Pro is used as a professional notebook, MacBook Air is ultra-thin, portable notebook, Mac Pro is a desktop computer defined as workstation. Beside this third party software and hardware supports made Apple ecosystem much stronger and effective. Apple ecosystem products as shown in Fig. 2.3.6, forms complete range of products satisfying needs of any user in every kind of usage, both private and professional.

2.4 COMPARISON OF GOOGLE AND APPLE ECOSYSTEMS

Both Google and Apple ecosystems have similarities in their architecture and operation. Essential services and application are similar. Even the mobile devices have similar formats and user interfaces. Comparison of Google and Apple ecosystems will be thus in the first place a list indicating corresponding elements of ecosystem. Such list is collected in Table 2.4.1.

	Google Ecosystem	**Apple Ecosystem**
Platforms	Android (Based on Linux) Open	iOS (Based on Unix) Proprietary
Devices	III-rd party smartphones and tablets	iPhone, iPad, iPod
Social Media and Communication	Google+	Twitter
Web Browser	Google Chrome	Safari
Online Market Place	Google Play	AppStore
Office Suite	Google Docs	iWork
Cloud Service	Google Cloud	iCloud
TV	Google TV	iTV
Search Engine	Google Search	Baidu(will be added in the near future in China)
Online Service	Gmail, Google Blog, Website, Google Page, iGoogle, Calendar etc.	MobileMe(WebApplications, Mobileme Beta Calendar, email service etc.)
Application Development Language	Java, some portion in C/C++	Objective-C

Table 2.4.1: Comparison of Google and Apple Ecosystem

From the Table 2.4.1 it can be seen that the differences between the Google and Apple system components are not essential since there are corresponding elements in each of them. There are differences rather due to slightly different formats of some

applications and services. This can be seen as the result of competition, each side has to provide functionalities offered by the other side in order not to give advantage to the competitor.

Although in some components and functionalities there can be seen certain advantages like e.g. in the Apple iTune superb music service, much more essential are differences in the philosophy of both ecosystems and the way of operation. Apple ecosystem is exclusive, based on proprietary hardware and software together with strict control of ecosystem components. Google ecosystem is basically open, founded on open software and allowing for many hardware platforms. However, Google keeps control of strategic elements of the ecosystem: search engine, map services and major application store. But in principle it is possible for others to create sub-ecosystems within the Google one if they are able to provide the required infrastructure, applications and services.

It is impossible to say now which ecosystem philosophy is better. Apple started its development earlier and gained a lead. Due to the fine mobile products and large ecosystem portfolio of applications and services, Apple got a base of devoted and faithful customers. The customers are tied to the Apple ecosystem in a way which can described as almost 'for life'. This is because users perceive this ecosystem as an exclusive one, offering high value and a great pleasure. On the other hand the Google ecosystem is addressing mass users, essentially by grabbing the mobile device market. The main power of this ecosystem results from huge number of users. Offering similar sets of applications and services Google ecosystem prevails over Apple due to its size but Apple has still a lead in the revenue. In the beginning of 2012 half of the users of mobile devices were using Android and a third Apple. The tendency is for Android to increase its market share. Android mobile devices tend to be innovating faster which may also have an impact on the market share.

One can thus conclude that although both ecosystems are now technically quite similar, it looks that Google ecosystem will be the leading one and Apple will be an exclusive niche - but comfortable in size. For Apple this could be a situation similar from its role in the PC area were for many years it has been a small but steady player in its own niche when most of the market was dominated by Microsoft. One should however take into account that due to its exclusive strategy Apple ecosystem is very profitable. There is thus still a possibility that using huge resources for innovation and perhaps for expanding the product range Apple may limit the expansion of Google and keep substantial market share in the future.

3 MICROSOFT SYSTEM COMPONENTS AND TOOLS

Microsoft has kept dominant position in computing for a very long time. Windows operating system had been near monopoly in PC area. Microsoft has also very large part of the professional software market. Microsoft has also managed to built substantial assets in the gaming area. For many years Microsoft has been also trying to enter the mobile device market but this was unsuccessful because Nokia and other mobile companies were afraid of losing control on their products. This has changed completely in the recent years with the emergence of Google and Apple ecosystems. Expansion of these ecosystems undermines position of Microsoft since PC is losing its status of an exclusive platform. As a result of this development Nokia and Microsoft joined forces to defend their positions. Their goal is to create third global ecosystem and Microsoft has primary role in this. Microsoft is a powerful company and has lots of products and services available in the market which could form a base for the ecosystem. In this chapter these products and services are reviewed.

3.1 SYSTEM COMPONENTS OVERVIEW

Microsoft major system components include

i. Windows operating system Windows 7 and 8
ii. Mobile operating system Windows Phone 7 and 8
iii. Windows Server
iv. Skype communication platform
v. Hotmail service
vi. Gaming platform based on Xbox
vii. Internet Explorer browser
viii. Bing search engine
ix. Lots of applications like Office, Zune
x. Sky Drive cloud service

When these components are put on the ecosystem architecture as shown in Fig. 3.1.1 one can see that Microsoft has everything in place – but these components do not form an ecosystem yet.

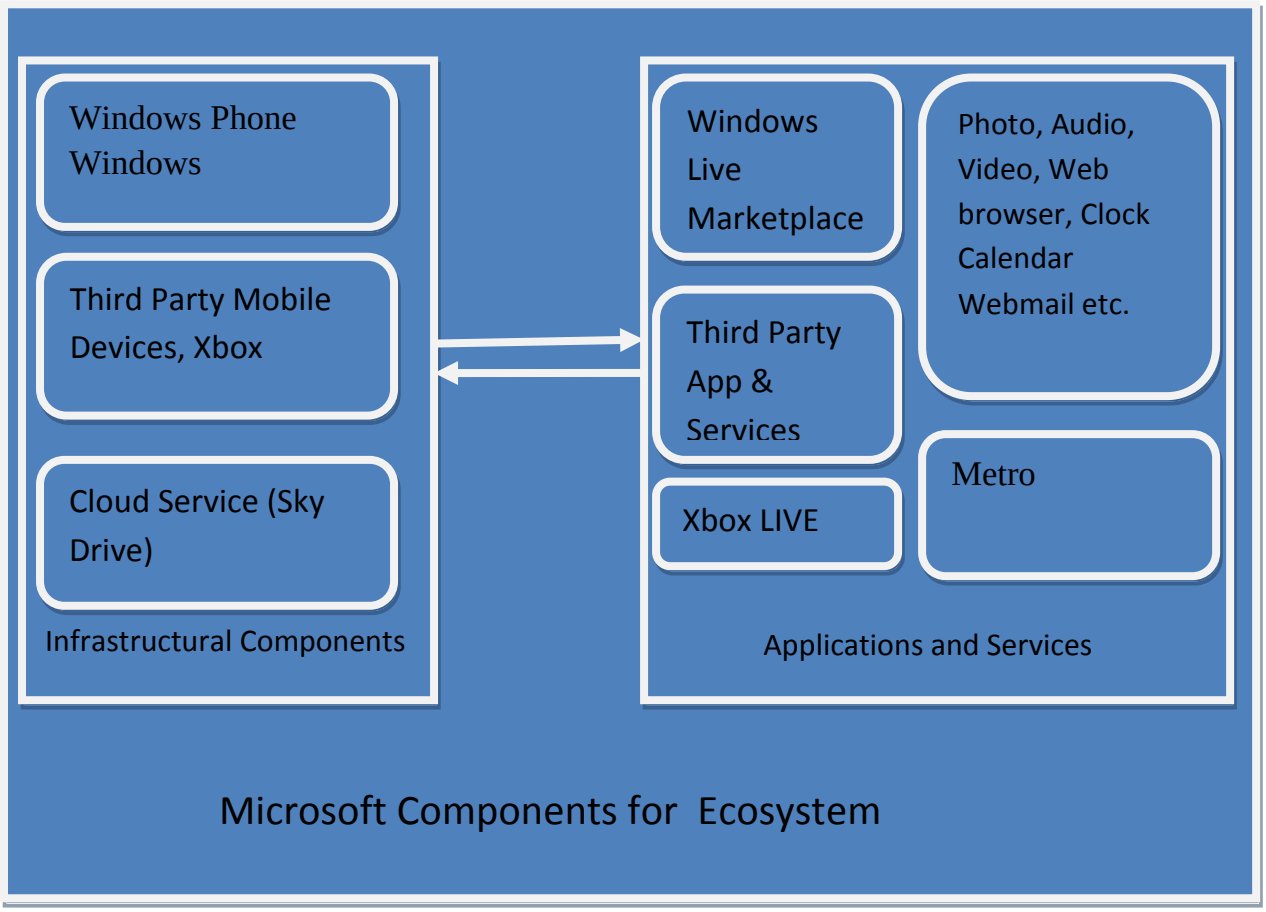

Fig. 3.1.1 Microsoft components for ecosystem

As in the other ecosystems, operating system is the foundation. Microsoft should be in strong position here since it has huge Windows base. Its major weakness is lack of presence in the mobile area. Following Apple, Microsoft is trying to solve this by adapting and transforming Windows to the ecosystem format. This process started with Windows 7 and Windows Phone 7 and is to be completed with Windows 8 and Windows Phone 8. Windows 8 platform will give Microsoft (and Nokia) solid foundation for an ecosystem. Major innovation in Windows 8 is user interface called Metro which has native touch screen support. This interface will be consistently available on all types of devices and thus a PC or tablet display will look and feel the same as a smartphone. Of course, when needed users will be able to use mouse and keyboard so the overall architecture will look like shown in Fig. 3.1.2. Metro visuals are based on the concept of active tiles which provide user with actual information about status of applications and services as shown in Fig. 3.1.3. This concept has been widely acclaimed as very innovative and challenging both Apple and Android.

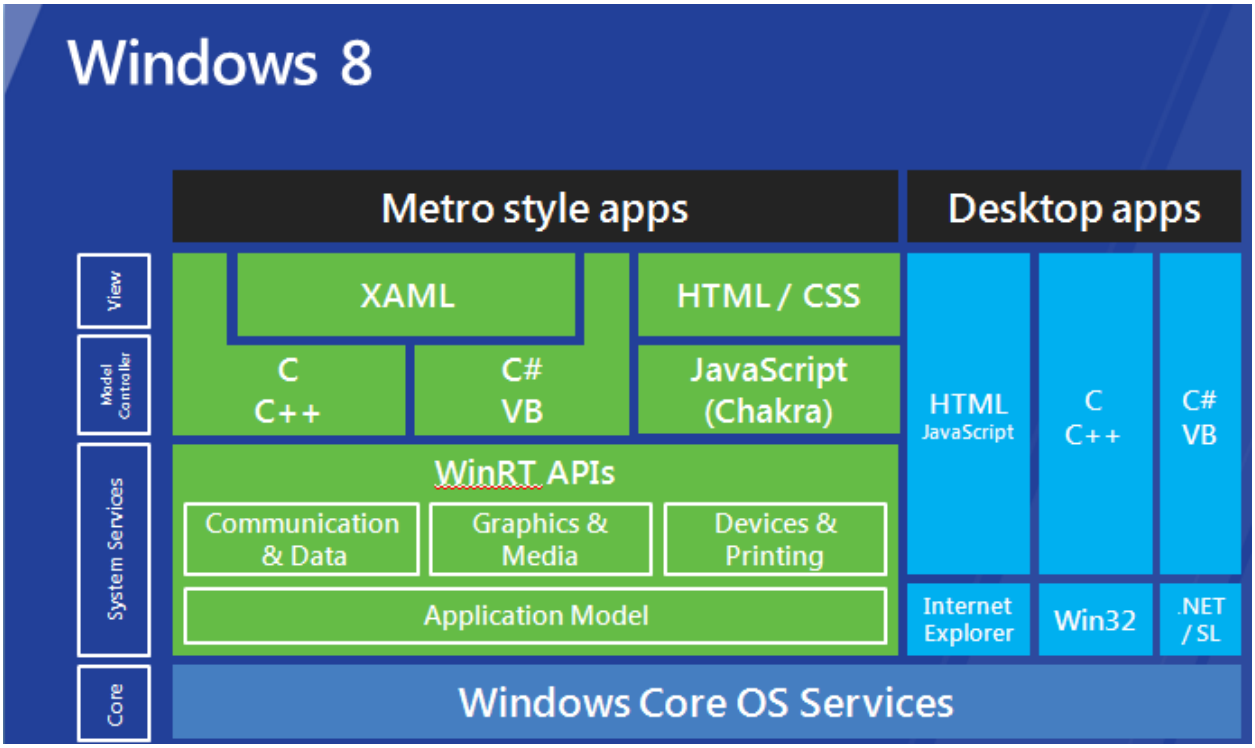

Fig. 3.1.2 Windows 8 architecture

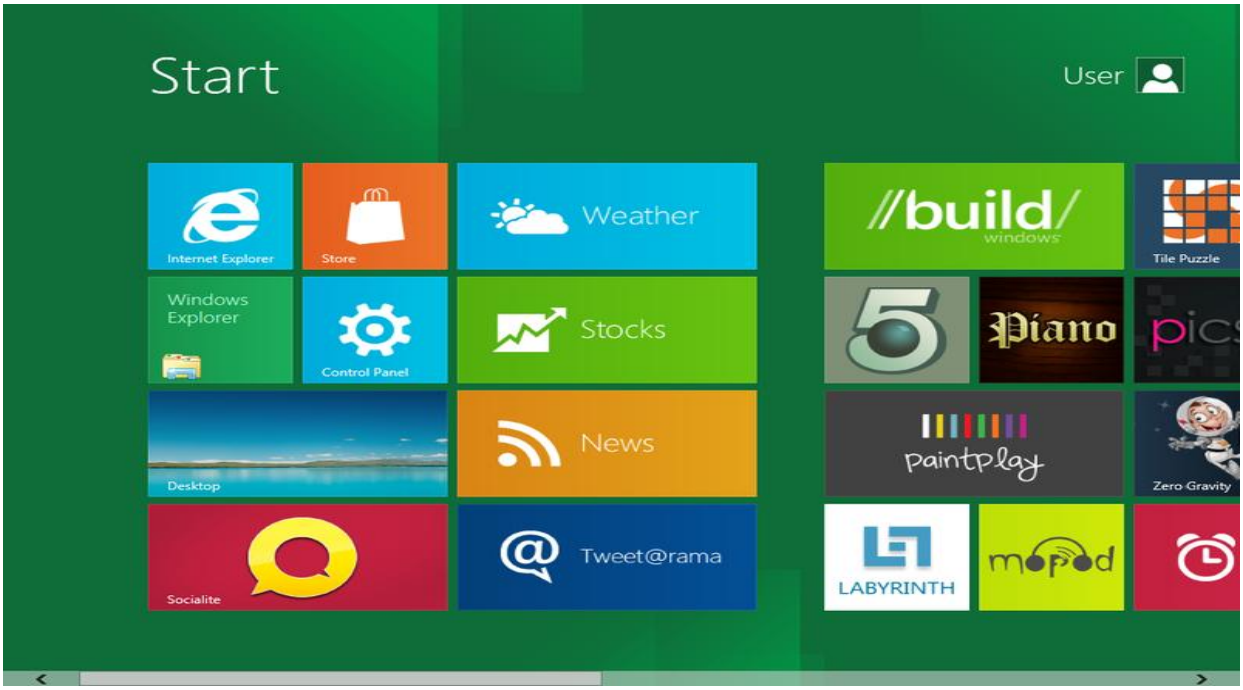

Fig. 3.1.3 Metro visual user interface

Beneath Metro there are operating system components which are typical in modern systems. Windows Phone 8 operating system will look very familiar to the Windows 8 user, but in its architecture there are emphasized components which are important for the ecosystem operation as shown in Fig. 3.1.4. The architecture of Windows Phone platform is composed of several major parts: Applications, App Model, UI Model,

Cloud Integration, Kernel and Hardware foundation, where each part is responsible for particular types of services and tasks. Components critical from the ecosystem point of view are listed under the heading of cloud integration and they are related to searching, location information, storage and applications like games. There is no mention of syncing of data between the devices but this is available.

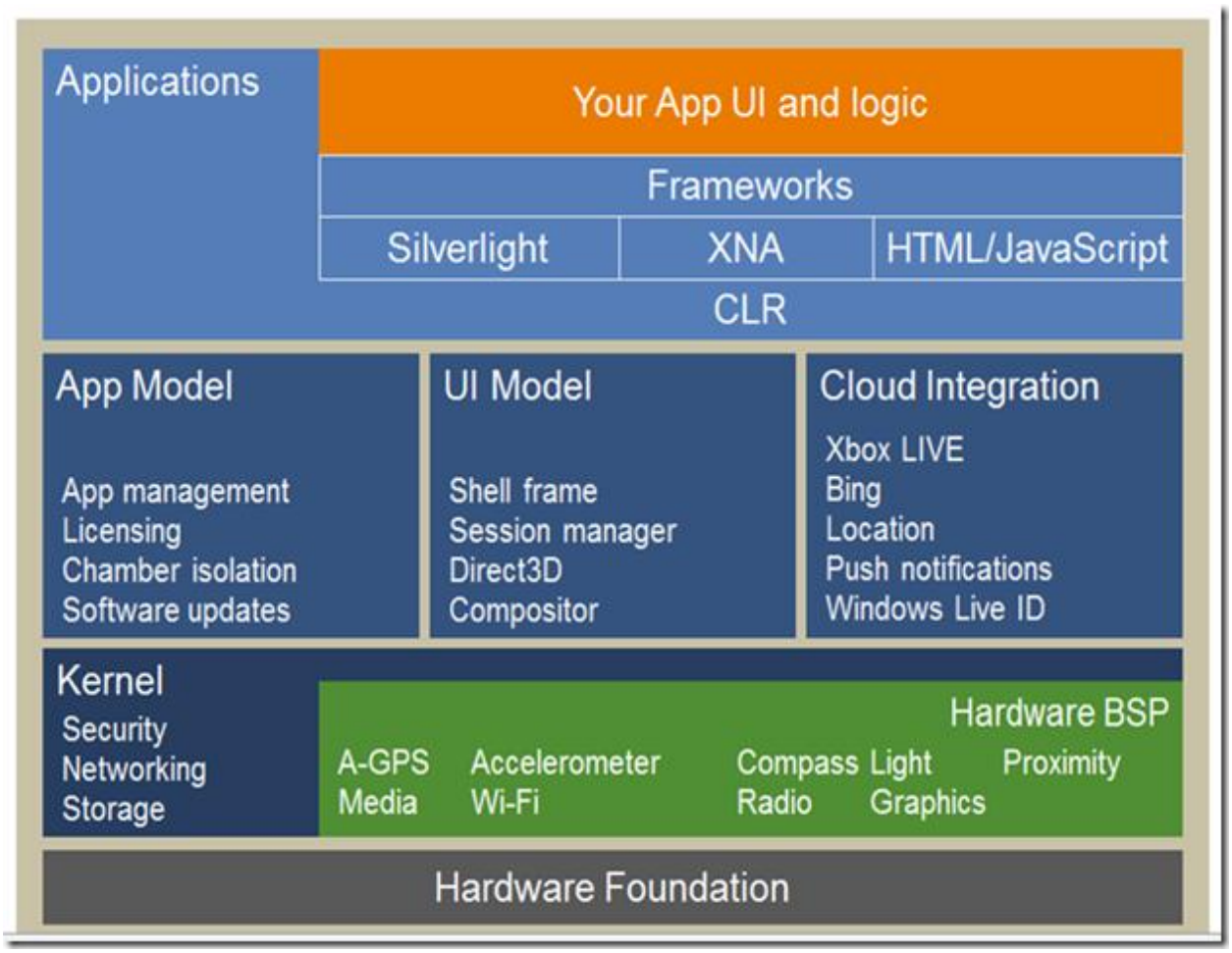

Fig. 3.1.4 Windows Phone architecture

From the user point of view Applications part of the architecture is the key element of responsible for various types of services and tasks like Your App UI and logic, Frameworks, CLR etc. Depending on the type of application specific type of Framework is selected for the implementation. For example Silverlight Framework is used to develop Web based application and XNA Framework is used for 2D and 3D games development. Applications with rich and extensible views having all types of modern contents like lists, grid, text boxes, and buttons are supported by those Frameworks. In result user interface and applications in Windows Phone have attractive modern view as illustrated in Fig. 3.1.5.

Fig. 3.1.5 Windows Phone interface

Microsoft cloud system is called SkyDrive. It offers free storage space and is integrated with key applications computing is another important component of Microsoft System components which has far beneficiary results on information sending and receiving introduced new era in communication arena. Like Apple and Google systems, documents created through Office Web Apps are automatically updated and synced with users SkyDrive account. SkyDrive users can share

documents with other SkyDriver users and also post documents to Facebook, MySpace or Linkedin.

Major components of Windows Phone 8 are

- Data Smart
- App-App communication
- Internet Explorer 10 Mobile
- Shared Components with Windows8
- Campaign experiences with windows8
- SkyDrive Integration
- Skype
- NFC and Wallet
- Local Scout
- Camera Improvements
- Business Features

Windows Phone 8 will include hardware accelerated encryption with BitLocker, Secure Boot capabilities, Exchange Active Sync policies, System center configuration settings, inventory capabilities and secure application share privately. Camera lens control will be more powerful. Internet Explorer 10 Mobile contains all latest web technologies;, its kernel, graphics, security model, sensor fusion, network all will come up from Windows 8 [3]. Data smart feature will be one of the highlighted features of Windows Phone 8, it aims to simplify and reduce data usage. Windows Phone 8 will support app-to-app communication as Windows Phone 8 applications and Windows 8 applications. A new feature is ”Wallet Experience”. Windows Phone 8 will allow users to pay and share files securely via the Near Field Communications (NFC).

3.2 Xbox AND LIVE SERVICE

Xbox is a shortcut used for describing the Microsoft gaming platform. Xbox is a video game console developed by Microsoft and released in 2001. At this time gaming was seen as the main market and Microsoft felt it cannot be outside it. Over the years Microsoft has built solid presence in this market which is shares nowadays with Sony Play Station and Nintendo Wii. The Xbox gaming platform gradually evolved to a service which offers now connectivity for multiplayer games and marketplace for buying games.

The offer has been also expanded to video and music. A runaway success for Microsoft was the introduction of Kinect sensor for Xbox which eliminates the need for a game controller by recognizing user body movements. This enabled applications going beyond traditional games and related to various physical activities like dancing and fitness. One should emphasize that Xbox is a highly successful platform and provides constant stream of revenue which according to some estimates is higher than from Windows. A distinctive component of the Xbox platform which in fact reaches beyond it and has big strategic importance is Xbox Live.

Windows Xbox LIVE

. Xbox LIVE is the online service for Xbox. Live was also available in Windows Phone and Windows as well but Microsoft is changing this eliminating separate name and replacing it with cloud services. LIVE for Xbox offers large variety of services:

i. Voice and Video chat
ii. Windows Live Messenger
iii. Xbox Live Marketplace
iv. Players achievement, user likeness through virtual avatar
v. Multiplayer's Gaming
vi. Cross platform multiplayer's gaming
vii. Netflix
viii. Zune
ix. Sky Go
x. Sky news and Sky sports
xi. Last.fm
xii. MSN
xiii. Game Room
xiv. ESPN Live
xv. Compatibility of Windows Phone
xvi. Hulu Plus
xvii. Bing
xviii. Cloud storage
xix. You Tube
xx. IPTV
xxi. Dailymotion

LIVE requires registration for online gaming and watching HD movies. Players need to pay fees to play online games with multi players. Video and voice chat features enable users to communicate online; Xbox Live Marketplace allows users to pay and download games, available products and applications; Netflix is an online movie service with wide selection. Last.fm provides the facility to hear radio stations. Hulu Plus is a video streaming service while MSN provides latest news from over the world, whike with ESPN user can view live and on demand sports up to 3500. Skype, and BBC iPlayer some other modern features is going to be added in the near future.

Xbox Live Marketplace

Xbox Live Marketplace is working as store room for free, premium content games from where user can download games and view original Xbox games, Xbox 360 game demos, trailers, pictures , television shows etc. In 2009 Zune application was introduced for the Xbox 360 which turns it into a Zune device which will provide flexibility to view marketplace menus and sections of the console.

Fig. 3.2.1 Windows Live Marketplace

User can now purchase movies and other products instead of rent through Zune Marketplace which is of addition of Xbox 360 console.

Social media

Xbox Live supports Facebook, Twitter, social network media which are accessible to the Xbox Live Gold subscribers (Fig. 3.2.2). Although all features of Facebook are not available via the Xbox console but user can see comments, status, update their status, view pictures of his own and friends, where in browser some extra features are visible to users. There is a nice correlation between Xbox Live Friend Finder and Facebook Friends Finder; Xbox Live Friend Finder allows to see those friends who use Xbox Live and Facebook Friend Finder allows to see those friends which Xbox Live friends use Facebook.

Fig. 3.2.2 Xbox social networking

From the point of service, applications and usage one see the Xbox platform as equally important asset of Microsoft as Windows. Xbox connection to gaming has unique features which are not offered by competitors from the ecosystem world.

4 MICROSOFT ECOSYSTEM TOOLS AND APPLICATION DEVELOPMENT PROCESS

Microsoft offers very wide set of tools for the application development. This can be important strategic asset for the creation of Microsoft ecosystem. This chapter provides overview of the tools and application development process.

4.1 MICROSOFT SYSTEM TOOLS

To develop Microsoft applications developer can easily download tools install them and start implementing applications. To develop Windows Phone application the following tools are required:

1. Visual Studio 2010
2. Expression Blend
3. Windows Phone Emulator
4. XNA Game studio
5. Sample, documentation, Guide and community.

Visual Studio is a powerful IDE (Integrated Development Environment) which gives assurance about code quality from the beginning to the end of application design and development [4]. Visual studio provides designer, debugger, project system, packager and manifest generation [5]. The most important part of application development of Windows Phone is to create Silverlight and XNA Framework, is included in Visual Studio IDE [6].

Expression Blend is used to design rich Internet Applications for desktop browser. Expression Blend for Window Phone allows designer to create XAML based interface for Windows Phone applications, whose behavior could then be implemented in Visual Studio [7].

To make the testing and debugging easier Window Phone Emulator is being integrated Visual Studio and Expression Blend. Application deployment, debugging and application execution are fully supported by the emulator [8].

The XNA Game Studio is used to build games. XNA Game Studio extends the visual studio tools to support XNA Framework [5]. XNA Game Studio includes tools to support graphical and audio content into your game [9].

Sample codes, documentation, sample applications are provided to guide developers to develop Windows Phone application. Forum, blogs are also available to ask

questions and share information with greater Windows Phone Community. Help system in Visual Studio will allow to updates documentation sets [10][11][12].

One of the important components of Microsoft software foundation is Framework, which is basically used for different kinds of application development, provides flexibility to user according to their specific criteria and requirements.

.NET Framework

The .NET Framework is a software framework based on Windows support for several programming languages and includes a large library. Common Language Runtime is a software environment keeps the contribution to execute program written in .NET Framework. For the purpose of security, memory management, exception handling services there is an application virtual machine. Common Language Runtime and Class library together constitute .NET Framework. Inside base class library things like user interface, data access, database connectivity, cryptography, and web application development are covered. Developers combined their own source code with .NET Framework, libraries and developed software. Looking forward to .NET software Microsoft produced Visual Studio which is working as integrated development environment.

Windows Phone Application Framework

Windows Phone application platform provides flexibility to developer to create new applications based on existing technologies like Visual Studio, Expression Blend, Silverlight Framework and XNA Framework where all of these technologies and related tools are familiar to developer, as an outcome they will be able to create new applications without spending lots of time to learn and used to with new tools and technologies. Two Frameworks are provided for developing applications

i. Silverlight Framework
ii. XNA Framework

Silverlight Framework

Silverlight Framework is used for developing rich media applications and user experiences and internet applications based on XAML, where the second one is used to develop games and entertainment. Extensible Application Markup Language (XAML) is used to define UI and code which integrates .NET classes and Library.

Silverlight Framework of Window's Phone 7 is a subpart of the full Silverlight functionality where some extra phone based APIs are added. Fig. 4.1.1 shows when Silverlight Framework is best suitable for application development.

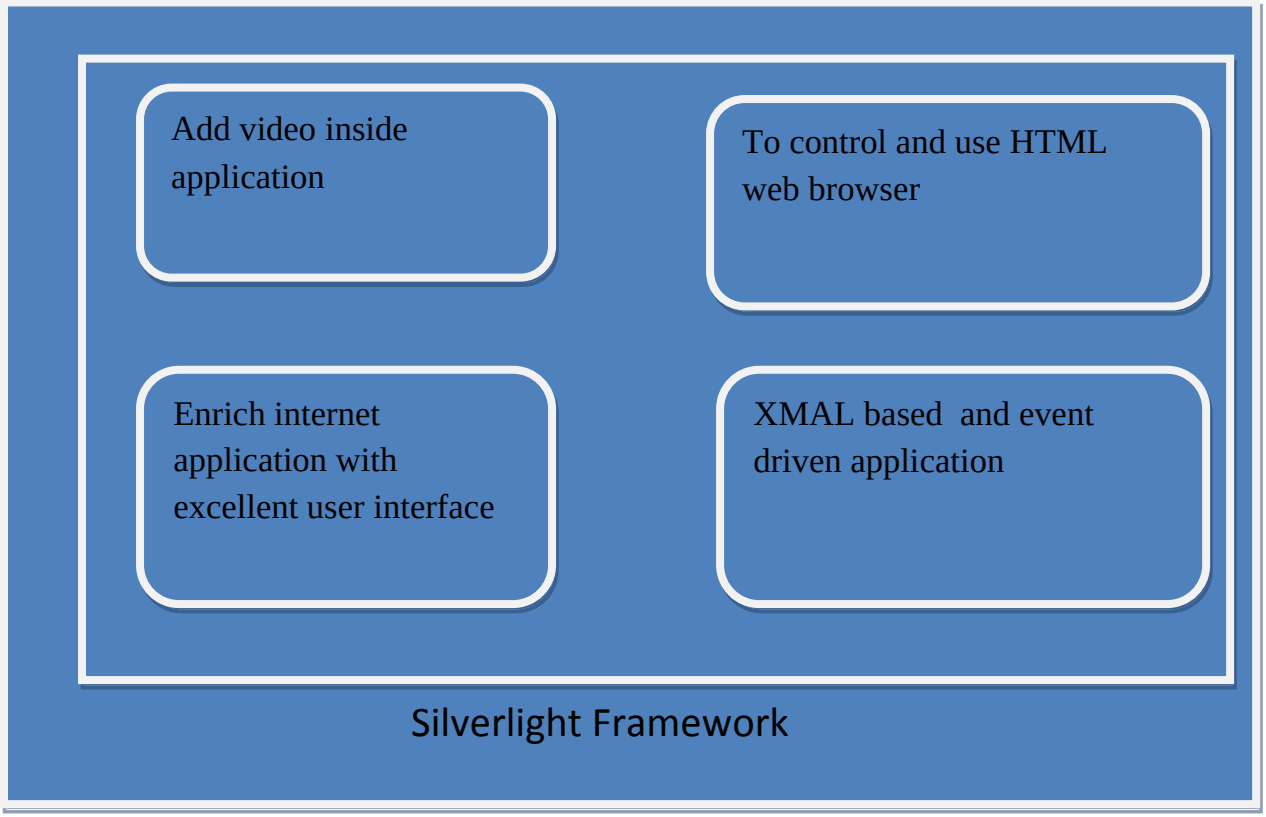

Fig. 4.1.1 Suitable feature of Silverlight Framework

Beside this the Silverlight Framework also focuses on the following features [13]

- UI rendering
- Webcam support
- Deep Zooming
- Layout
- Networking
- Data binding
- Isolated storage
- Runtime controls
- XAP packaging
- LINQ

The Silverlight Framework is also being used for Windows application development, but some extra feature have been added to Silverlight Framework for Windows Phone[13]:

- Software Input panel(SIP)
- Gesture aware controls
- Manipulations events for touch input

Supporting the most of the important features the Silverlight Framework does not support the following ones [13] which are provided by other components

- JavaScript
- Dynamic language runtime
- Drag and Drop
- Right Click
- Printing
- Hosting application in browser

XNA Framework

3D graphics application are very popular at, especially the3D games. Normally we are used to games running in desktop computers or consoles, but now with the strong hardware a tiny mobile phone is able to overcome the difficult problem of three dimensional graphics rendering. In result it is possible to provide 3D graphics in a mobile device. XNA Framework in Windows Phone enables to create 2D and 3D graphics applications. Fig.4.1.2 shows when XNA Framework is best suitable for application development. XNA Framework allows creating applications for Windows, Xbox 360, and Windows Phone7. This technology is being created such a way so that developing applications can adjust with different platform easily. XNA Framework for Windows is based on .NET Framework where .NET Compact Framework is for Xbox360 and Windows Phone 7; graphics part is based on DirectX 9 [14].

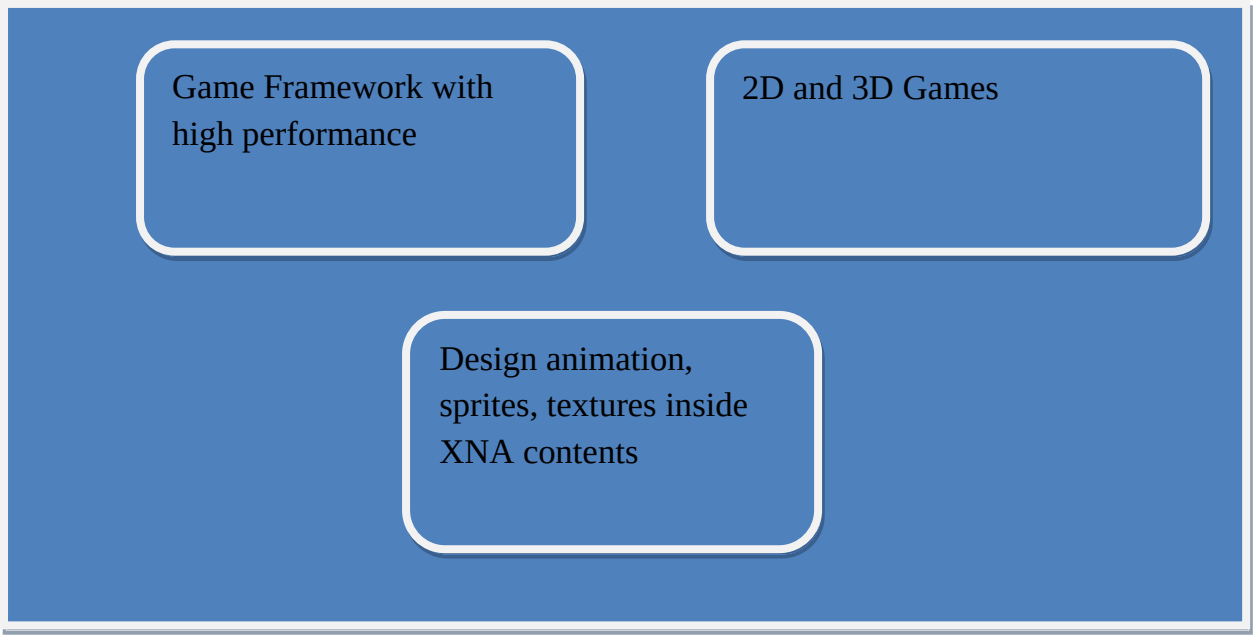

Fig. 4.1.2 Features of the XNA Framework

XNA Framework contains all required library for developing games for example math library which includes all necessary problem solving things like matrixes, vectors etc. With correspond of this it also includes Extended Framework which will solve problems when developers will face problems to develop games. Content pipeline and Application model consists this Extended Framework.

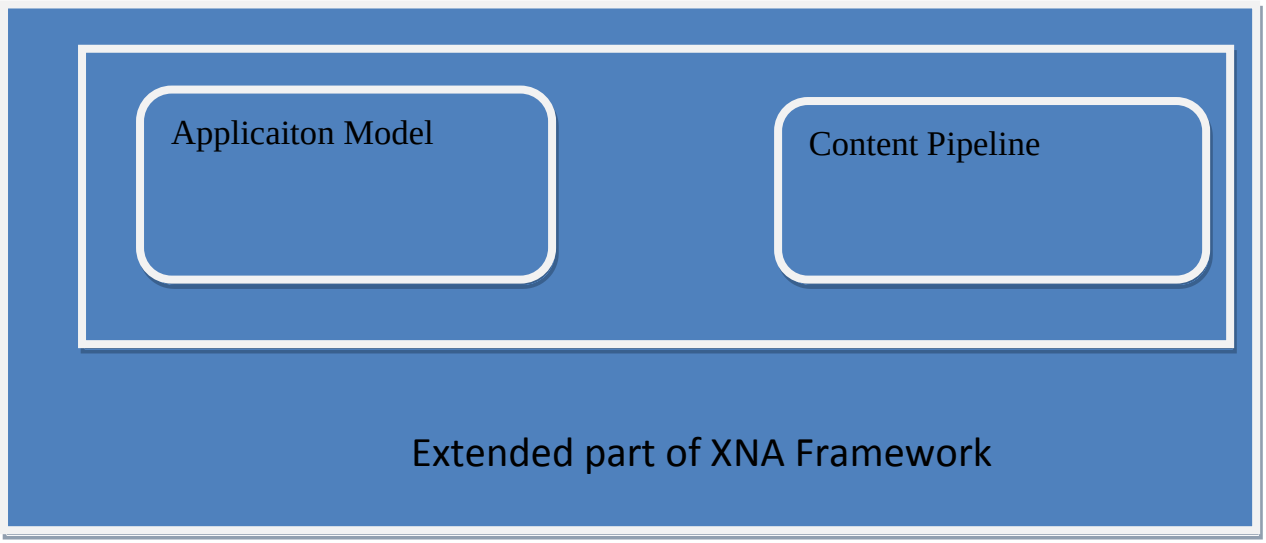

Fig. 4.1.3 Extended part of XNA Framework

In Core Framework part there are Graphics, Audio, Input, math, Storage are available.

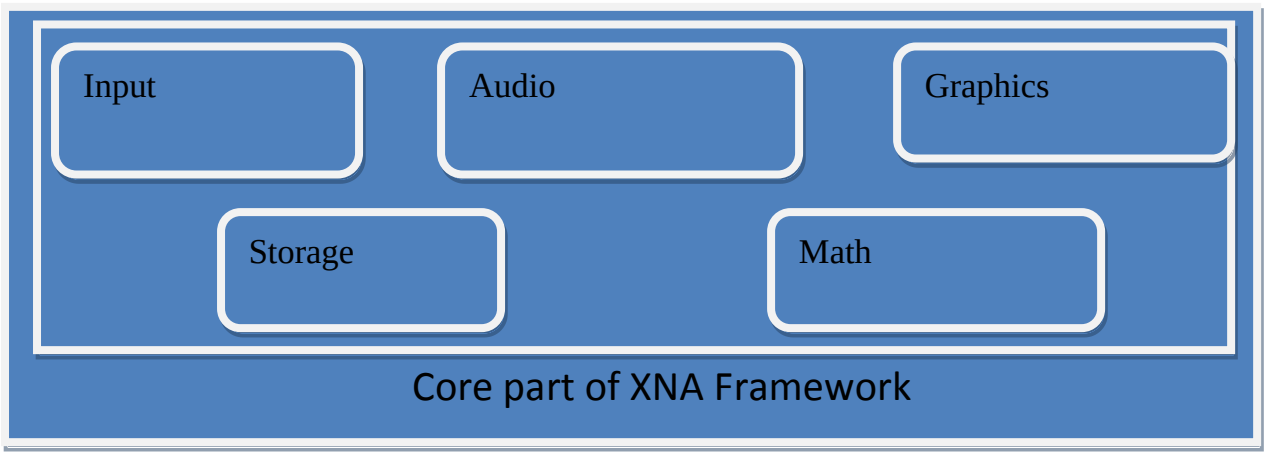

Fig. 4.1.4 Core part of XNA Framework

From the following figure we can have a visual idea regarding the principle work of XNA Framework [14]-

Fig. 4.1.5 Principle work of XNA Framework

If we integrate these frameworks together it will provide facilities to develop –

- High performance Game application based on XAML and event driven
- Enrich user interface of internet application which support 2D and 3D games
- Integrate powerful graphics of XNA with Silverlight page navigation application which will make application more attractive.

4.2 APPLICATION DEVELOPMENT

To develop Window's Phone application the developer has to go through some steps. It starts with the App Hub through which developer would be able to sign up and get Windows Live ID [5]. Developer will get the SDK to install and implement application through Visual Studio and Expression Blend; beside this the developer will get all related licenses and documentations. Through the registration process developer can get retail set for testing their implemented application whether everything working fine according to their specification.

After the registration process developer starts to design application and produce application package through Visual Studio and Expression Blend. XNA Framework is used for games and graphics based applications and Silverlight Framework is used to develop XAML based application. From version 7.5 it is possible to integrate Silverlight and XNA Framework into single application [15]. As an IDE Visual studio is doing all other tasks to support application, when application is done Visual Studio creates a package which includes all related things to run the application successfully.

It is possible to debug the program in Windows Phone emulator or on a phone. As a result it will provide a package which will be based on debugging platform. Different kind of windows to observe call stack, expression evaluation, and variable are supported.

When the application is ready to use the developer can make the program available to all other users through the Windows Phone Marketplace. For publishing the application developer submits and .xap file, compressed file which contains all available information to run the application. Beside this there is also an icon, a start title, metadata, licensing terms mentioning how to use their programs. After this the developer submits the application package for clarification through App Hub to get certification. In this process the application will be verified whether this application is doing something wrong with the phone, whether the application is running as it should and also whether it is running using all the supported languages. After getting Windows Marketplace certification developers are notified about this and they can publish application to Windows Phone Marketplace by which application is available

to consumer to download. Mobile operator billing and credit card are supported according to the sales condition.

The fig. 4.2.1 shows the application development process from the beginning to ending of the life cycle [5].

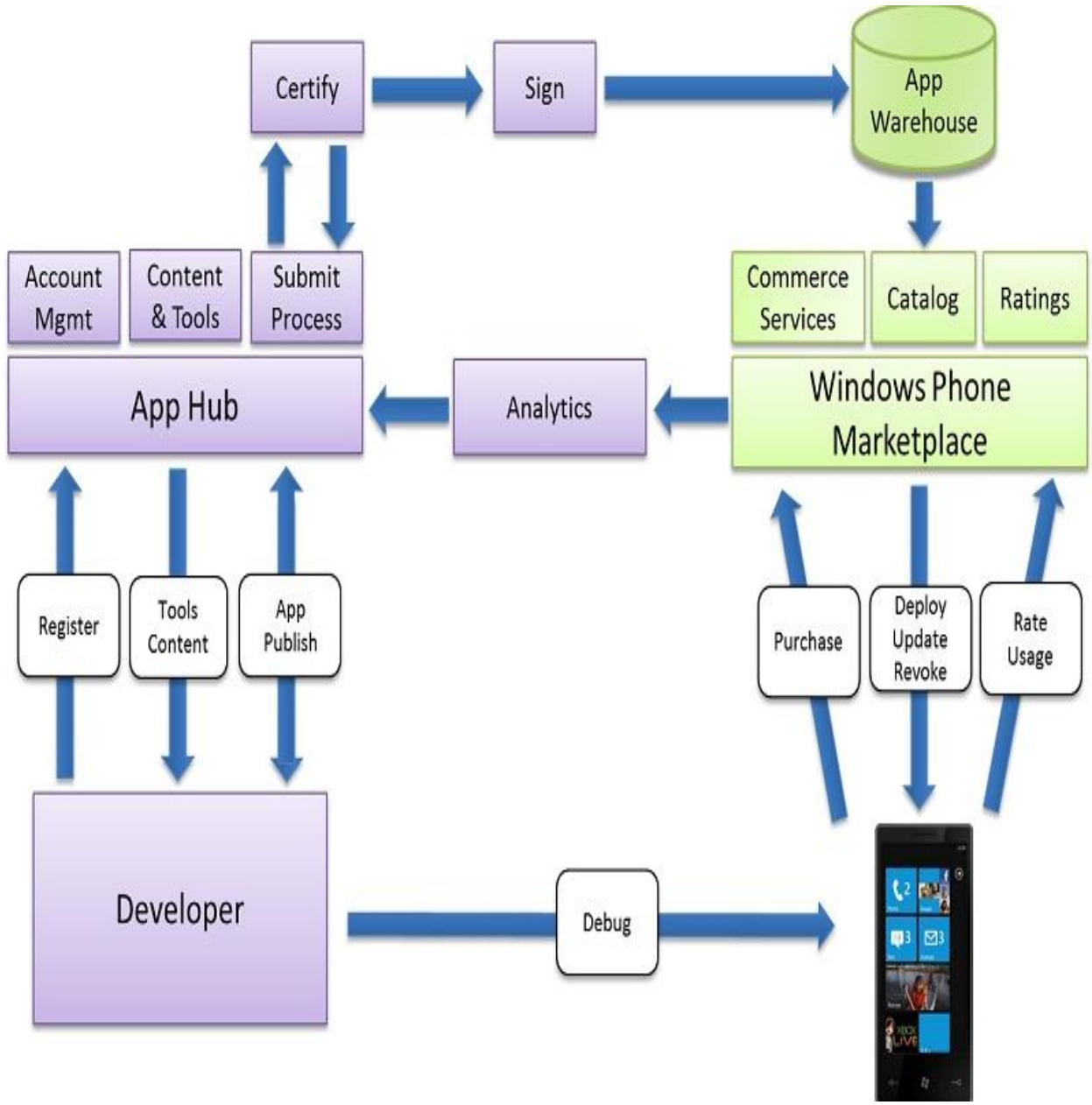

Fig. 4.2.1. A visual diagram to observe the whole process of application development.

We shall illustrate the application development process on an example which will make it easier to understand how the visual Studio 2010 Express for Windows Phone operates to develop User Interface of an application.

First one needs to create a new project, selecting new project option will show you the options whether you want to create Silverlight Application or XNA Application; depending on your template selection it will open the window with all the related information like the project name, location directory etc. Fig. 4.2.2 shows how to create Windows Phone Application with Silverlight Templates.

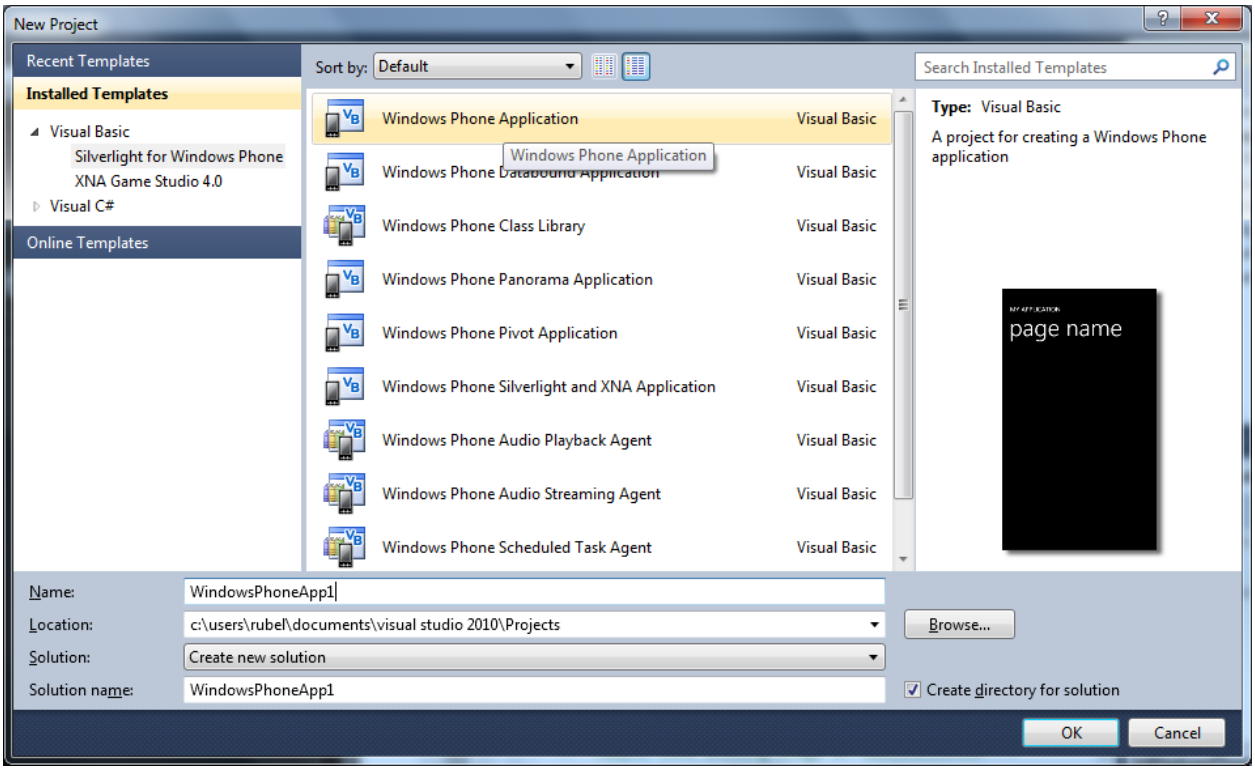

Fig. 4.2.2 Create Silverlight applications using Visual Studio 2010 Express for Windows Phone

After creating the project you one finds the following page (Fig.4.2.3) with related important files which are under the Solution at the right side of the following figures. To get the Toolbox to design the UI one has to press Ctrl+Alt+X, using Toolbox. At the right corner downside there is properties option by which when you will select any

toolbox item properties will show the details of the corresponding item. SplashScreenImage.jpg will be shown when user will first time start the application.

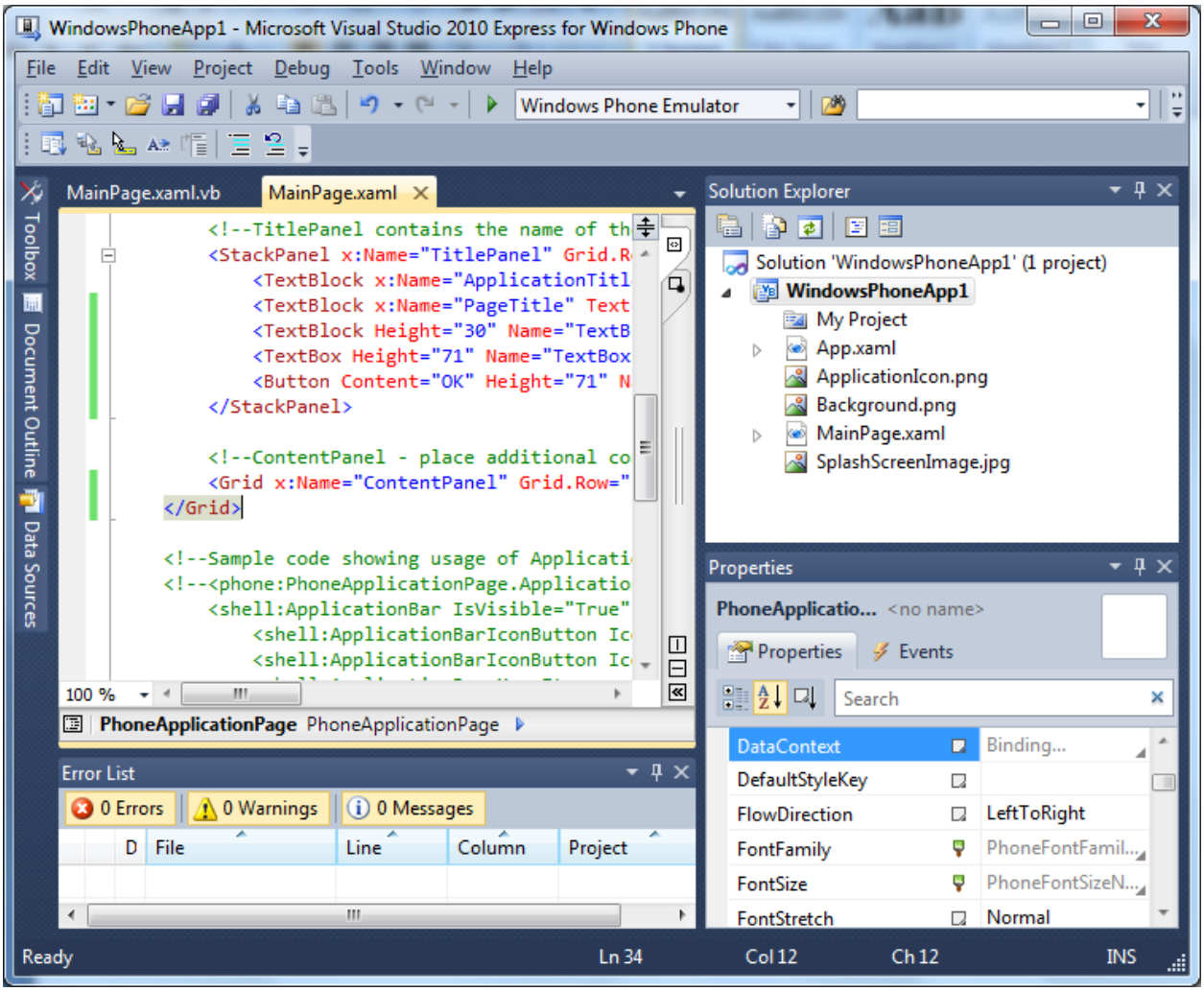

Fig. 4.2.3 After creation of project file to develop Silverlight application for Windows Phone

The following figure gives an idea how to fix your design by changing properties option using Visual Studio 2010 Express for Windows Phone.

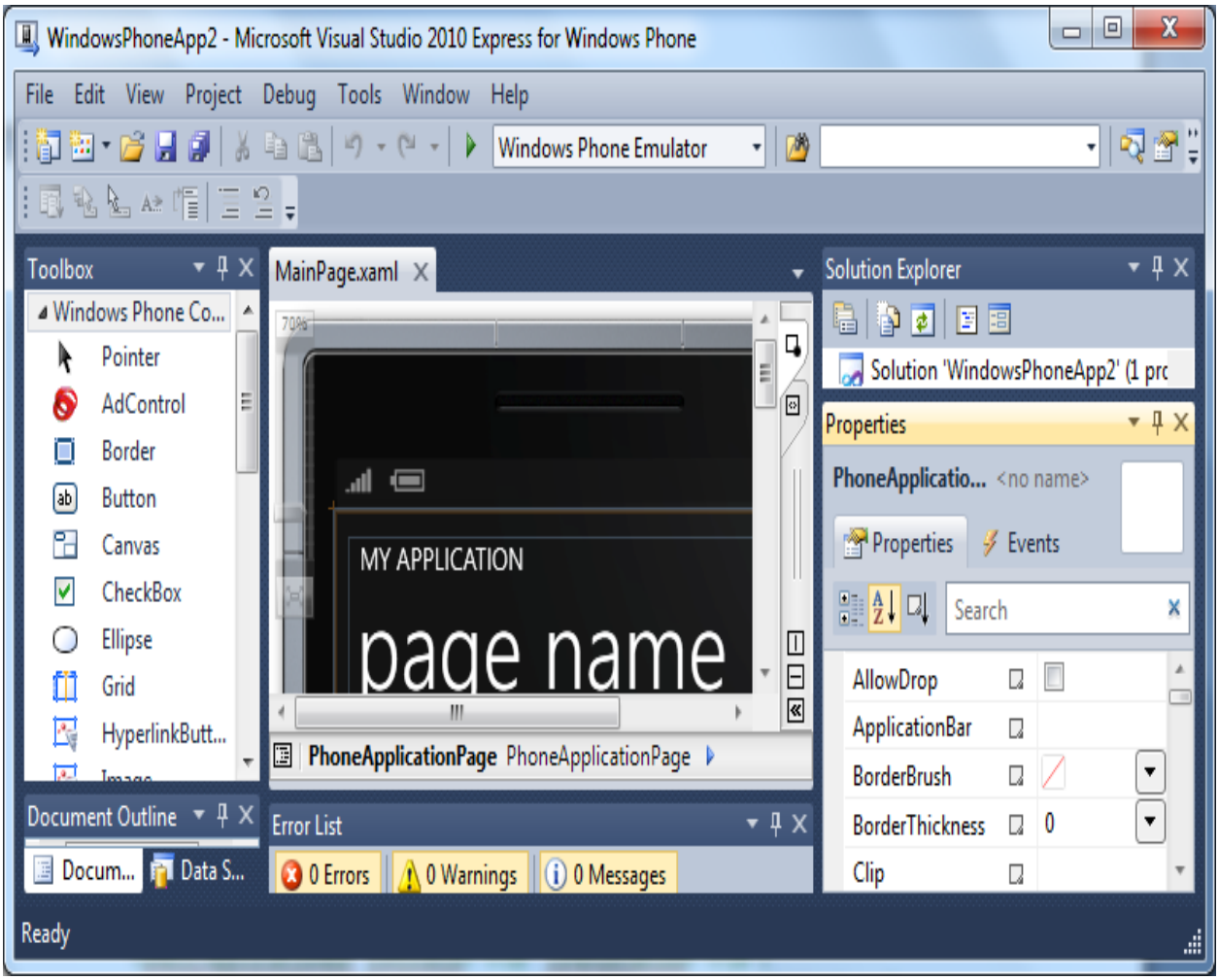

Fig. 4.2.4 Visualization of properties option to fix your design for Windows Phone

The following figure shows the Toolbox contents and design preview where you can add button, text, image, grid, checkbox etc. according to design your application.

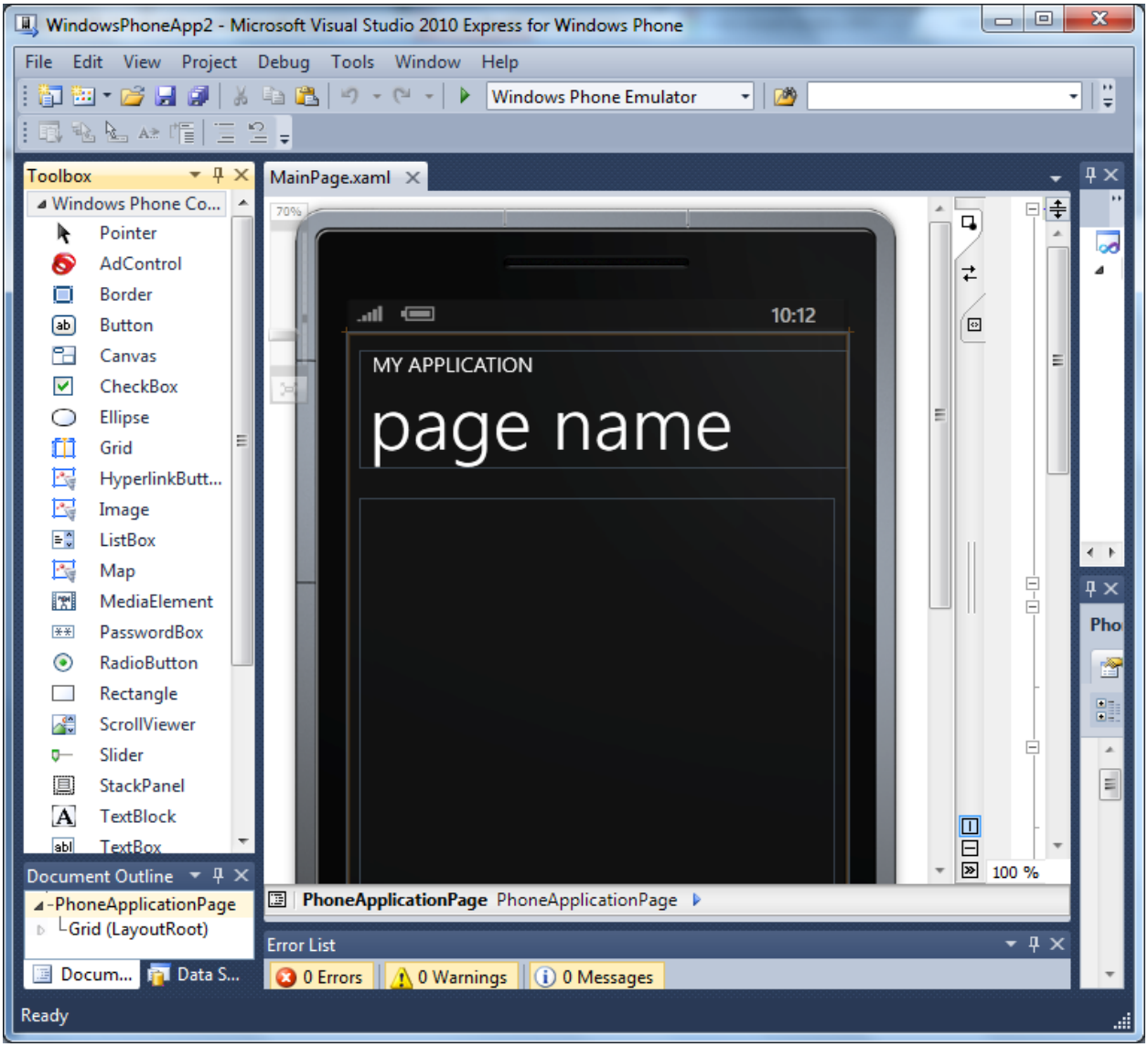

Fig. 4.2.5 Toolbox and Phone emulator

This is a very simple design which helps to get idea regarding the entire design of application.

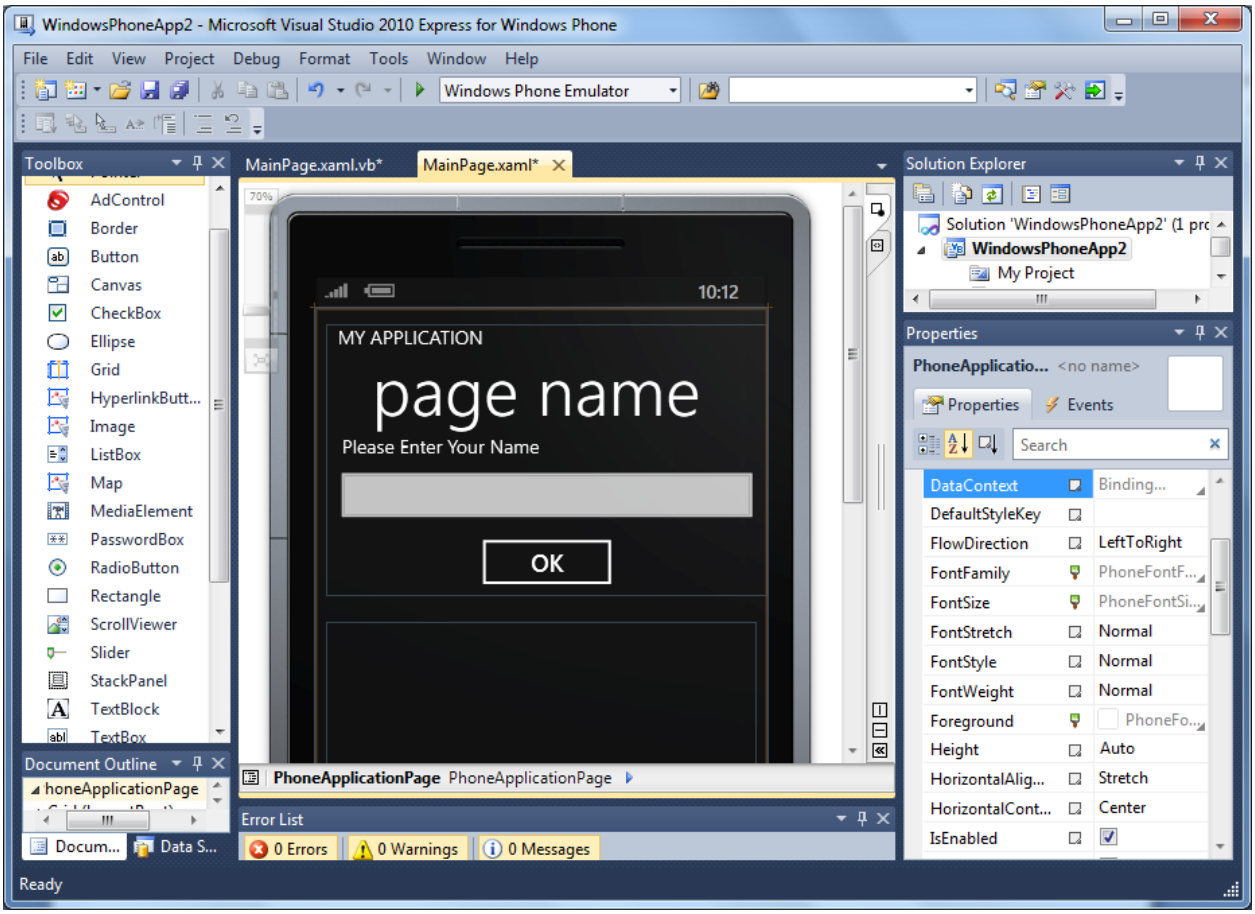

Fig. 4.2.6 Phone emulator with design interface

This code will be generated automatically when you will design your own UI. I have added one Text Box, one Text Block and One button, as expected I got this auto generated code. You can also modify your design through proper coding.

The following code is from the App.xaml file

```
<Application
   x:Class="WindowsPhoneApp1.App"
   xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation"
   xmlns:x="http://schemas.microsoft.com/winfx/2006/xaml"
   xmlns:phone="clr-namespace:Microsoft.Phone.Controls;assembly=Microsoft.Phone"
   xmlns:shell="clr-namespace:Microsoft.Phone.Shell;assembly=Microsoft.Phone">



<!--Application Resources-->
   <Application.Resources>
   </Application.Resources>

 <Application.ApplicationLifetimeObjects>
       <!--Required object that handles lifetime events for the application-->
       <shell:PhoneApplicationService
          Launching="Application_Launching" Closing="Application_Closing"
          Activated="Application_Activated" Deactivated="Application_Deactivated"/>
   </Application.ApplicationLifetimeObjects>
</Application>
```

This code belongs to MainPage.xaml depending on the UIdesign

```
<phone:PhoneApplicationPage
   x:Class="WindowsPhoneApp1.MainPage"
   xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation"
   xmlns:x="http://schemas.microsoft.com/winfx/2006/xaml"
   xmlns:phone="clr-namespace:Microsoft.Phone.Controls;assembly=Microsoft.Phone"
   xmlns:shell="clr-namespace:Microsoft.Phone.Shell;assembly=Microsoft.Phone"
   xmlns:d="http://schemas.microsoft.com/expression/blend/2008"
   xmlns:mc="http://schemas.openxmlformats.org/markup-compatibility/2006"
   mc:Ignorable="d" d:DesignWidth="480" d:DesignHeight="768"
   FontFamily="{StaticResource PhoneFontFamilyNormal}"
   FontSize="{StaticResource PhoneFontSizeNormal}"
   Foreground="{StaticResource PhoneForegroundBrush}"
   SupportedOrientations="Portrait" Orientation="Portrait"
   shell:SystemTray.IsVisible="True">
```

```
<!--LayoutRoot is the root grid where all page content is placed-->
    <Grid x:Name="LayoutRoot" Background="Transparent">
        <Grid.RowDefinitions>
            <RowDefinition Height="Auto"/>
            <RowDefinition Height="*"/>
        </Grid.RowDefinitions>

        <!--TitlePanel contains the name of the application and page title-->
        <StackPanel x:Name="TitlePanel" Grid.Row="0" Margin="12,17,0,28">
            <TextBlock x:Name="ApplicationTitle" Text="MY APPLICATION"
Style="{StaticResource PhoneTextNormalStyle}"/>
            <TextBlock x:Name="PageTitle" Text="First Application" Margin="9,-7,0,0"
Style="{StaticResource PhoneTextTitle1Style}"/>
            <TextBlock Height="30" Name="TextBlock1" Text="   Please Enter Your Name" />
            <TextBox Height="71" Name="TextBox1" Text="" Width="460" />
            <Button Content="OK" Height="71" Name="Button1" Width="160"
FlowDirection="RightToLeft" />
        </StackPanel>

        <!--ContentPanel - place additional content here-->
        <Grid x:Name="ContentPanel" Grid.Row="1" Margin="12,0,12,0"></Grid>
    </Grid>

    <!--Sample code showing usage of ApplicationBar-->
    <!--<phone:PhoneApplicationPage.ApplicationBar>
        <shell:ApplicationBar IsVisible="True" IsMenuEnabled="True">
            <shell:ApplicationBarIconButton IconUri="/Images/appbar_button1.png"
Text="Button 1"/>
            <shell:ApplicationBarIconButton IconUri="/Images/appbar_button2.png"
Text="Button 2"/>
            <shell:ApplicationBar.MenuItems>
                <shell:ApplicationBarMenuItem Text="MenuItem 1"/>
                <shell:ApplicationBarMenuItem Text="MenuItem 2"/>
            </shell:ApplicationBar.MenuItems>
        </shell:ApplicationBar>
    </phone:PhoneApplicationPage.ApplicationBar>-->

</phone:PhoneApplicationPage>
```

Below is the code which generates automatically when the OK button is clikced. This code belongs to MainPage.xaml.vb

```
Partial Public Class MainPage
    Inherits PhoneApplicationPage

    ' Constructor
    Public Sub New()
        InitializeComponent()
    End Sub

    Private Sub TextBox1_TextChanged(sender As System.Object, e As
System.Windows.Controls.TextChangedEventArgs) Handles TextBox1.TextChanged

    End Sub

    Private Sub Button1_Click(sender As System.Object, e As
System.Windows.RoutedEventArgs) Handles Button1.Click

    End Sub

End Class
```

After running the program following UI, which is integrated with Windows Phone default applications.

Fig. 4.2.7 Application view after execution

Left side picture is my application view what I got after execution of program, after pressing back button I found the right side view. The left side view is found after press next option where the application name is also showing in the screen. Right side picture is showing some default application support which you can see beside your application. After clicking on search option one finds that built in application view.

Fig. 4.2.8 Default application of Windows Phone included with implemented application

User can change Application Icons and Splash Screen, where ApplicationIcon.png must have the size of 62*62 pixels and Background.png 173*173 pixels. To see the changes effected properly after execution of program once again, press back button to emulator and icon should display.

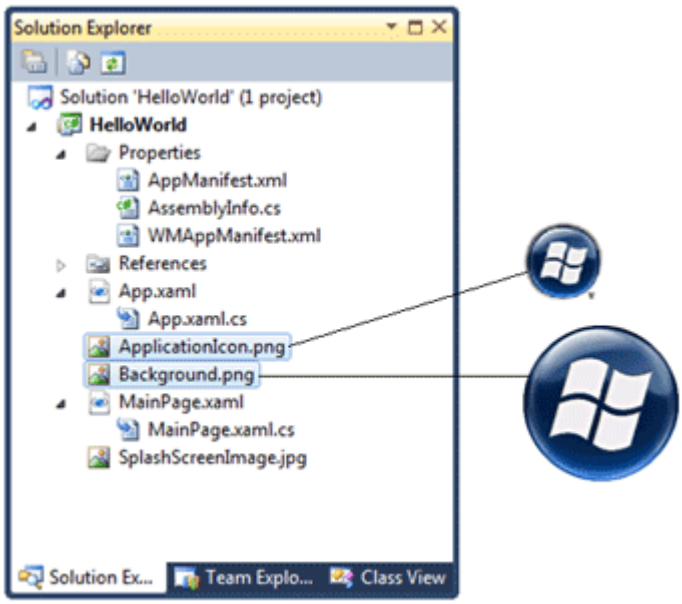

Fig. 4.2.9 Option to change background and icon image

To pin the application onto the start screen one needs to click on the application icon and hold it for a second, selecting pin to start option will show the background.png image on the start screen. In the same way it is possible to change the SplashScreenImage.jpg file with any selected image with resolution 480*480 pixels.

Deploying the Application

Instead of Visual Studio it is possible to run the application in Windows Phone emulator or device. When running application in Visual Studio using F5 button, Visual Studio binds Application into an XAP file, located inside bin/Debug or bin/Release folder of project. This XAP file is a zip file containing all related files and resources of the project. Using the Windows Phone Tools it is possible to install Application directly on the Windows Phone emulator or device without Visual Studio.

5 CHALLENGES IN THE CREATION OF MICROSOFT ECOSYSTEM

Microsoft strength is in the breadth of its product portfolio. It has all components for building of an ecosystem. Comparison with competitors shown in Table 5.1 indicates Microsoft has certain unique strengths like the well-established gaming platform or enormous skills and experience in the operating systems.

	Microsoft Components	**Google Ecosystem**	**Apple Ecosystem**
Platforms	Windows Phone 8 Windows 8	Android (Based on Linux)	iOS (Based on Unix)
Devices	IIIrd party smartphones and tablets	IIIrd party smartphones and tablets	iPhone, iPad, iPod
Social Media and Communication	Windows Live, Skype	Google+	Twitter
Web Browser	Internet Explorer	Google Chrome	Safari
Online Market Place	Windows Live Marketplace	Google Play	AppStore
Office Suite	Microsoft Office	Google Docs	iWork
Cloud Service	Microsoft Cloud(Sky Drive)	Google Cloud(Google Drive)	iCloud
TV	Microsoft TV	Google TV	iTV
Search Engine	Bing Search	Google Search	Baidu(will add near future in China)

Online Service	Hotmail, Calendar, MSDN Blog etc.	Gmail, Google Blog, Website, Google Page, iGoogle, Calendar etc.	MobileMe(WebApplications, Mobileme Beta Calendar, email service etc.)
Application Development Language	C#, Visual Basic	Java, some portion in C/C++	Objective-C
Gaming Platform	Xbox	Mobile games from Google Play	AppStore games

Table 5.1: Microsoft building blocks vs. competitor ecosystems

As one can see from the Table 5.1 Microsoft has some unique features which are placing it in some way between the competitors while it has components corresponding to every component of the competitors' ecosystems:

- Windows operating system is proprietary which is the same as Apple iOS but Microsoft licenses mobile version of it to other vendors like Google does.

- Google Android in turn is much more flexible than Apple or Microsoft with the adaptation to different hardware. Microsoft licenses others to use its mobile software but tends to specify hardware requirements strictly which is just like Apple. This lows down the pace of innovation characteristic comparing to Android.

- Unique feature of Microsoft is its gaming platform which can be seen as a kind of its own ecosystem in the gaming world. On the other hand competitors have nowadays plenty of games available.

- Other components are largely corresponding though in many of them the position of Google and Apple is more advanced (e.g. Cloud, AppStore services).

One can ask of what is missing and why the Microsoft ecosystem really does not exist. General answer to this would list the following items:

- There is no unification among the different components based on user perception and money flows. Consumers see different platforms, devices and applications, e.g. Windows is seen as totally different from Xbox and their way of dealing with applications is different.
- Fundamental weakness in lack of presence in mobile and portable devices which became primary devices for dealing with the ecosystems.
- There is no significant AppStore which could attract large community of developers and applications. In consequence there is no ecosystem business and money flow.
- Mobile presence is almost non-existing which is huge problems since consumers do not associate Microsoft as the ecosystem company.
- Critical services for the ecosystem are weak due to small customer base (AppStore, Cloud).

The question if is Microsoft can succeed in building its own ecosystem. Several basic argument in favor of it are:

- Microsoft is a company with great strength and resources. They have record of ability to launch new innovative products and services, recent example of this is Kinect sensor for games.
- It has all components for the ecosystem though the integration is missing.
- Microsoft made big progress in unifying of its components. This will be seen when Windows 8 and Windows Phone 8 will arrive.
- Nokia is strong mobile partner of Microsoft on the mobile hardware side.

However, there are quite a few factors making the establishing of own ecosystem by Microsoft difficult:

- Apple and Google are well-established and quickly growing.
- Google is becoming dominant due to the huge hardware base while Apple is occupying exclusive niche, there may be no space for another player.
- Microsoft and Nokia are late to the ecosystem market since they will really start only when Windows 8 and Windows Phone 8 will arrive.

- There is brand image problem: Microsoft is associated with the PC world while Nokia with the previous generation of mobile technology.

Microsoft and especially Nokia realize that their future is at stake, if they do not succeed in the ecosystem world, they may be left to a small niche and later to extinction.

As the analysis shows, they have all necessary skills, resources and components. They still miss scope of products (mobile and tablet devices), integration and the ecosystem brand image. This all can be solved by committing sufficient resource. The most critical however is the speed with which things can be done.

Thus it looks that the most important prerequisite for Microsoft and Nokia to succeed is speed to keep the innovation pace:

- Microsoft speed of operation: Microsoft should shape the Windows Phone 8 system to be quickly adaptable to different hardware and make for new version releases like in Android, at the same trying to polish operation to the level of iPhone and beyond, Microsoft should integrate all components very quickly.

- Nokia speed of operation: Nokia should be releasing Windows Phone products matching or exceeding technological level of competitors while at least maintaining their speed.

The speed requirement demand transformation of both companies. Microsoft can not think anymore about new versions release every couple of years. Nokia can not think about hardware specifications and speed which are not on the level of competitors.

6 CONCLUSION

Mobile ecosystems become central information technology infrastructure of present society. Their significance stems from the fine integration of mobile devices with the Internet and the Web, and providing huge variety of applications and services. One can expect that in a near future mobile ecosystems will impact every person as much as the Internet today. Ecosystems have thus strategic importance for the society and the development of information technology. In a very short time ecosystems made by two US companies Google and Apple have established themselves as dominant forces in the development of mobile technology and information systems. This has led to diminishing the role of the traditional mobile technology leader Nokia and is reducing the role of long time information systems leader Microsoft. Both of them have to react in order to avoid marginalization. In this thesis the position of Microsoft in creating the third mobile ecosystem is analyzed. Analysis shows that Microsoft has many strengths which could be used for the creation of an ecosystem together with Nokia. Microsoft has all components for the ecosystem corresponding to the ecosystems of Google and Apple. Microsoft operating systems Windows 8 and Windows Phone 8 are on par or better than the competitors' Android and iOS. Microsoft has certain unique advantages like wide presence in professional systems and applications and strong gaming platform based on Xbox. There are also some big problems on the Microsoft side. One of them is lack of presence in mobile devices, this possibly can be solved by the cooperation with Nokia and other manufacturers of Windows Phone 8 devices. Some of the Microsoft components needed for the ecosystem exist, but are very small, like application store Another big problem is lack of integration of components in such a way that users will see a common Microsoft ecosystems. All these problems can be solved given that Microsoft is a company with huge resources and able to react efficiently. Thus, the last and biggest issues of all is in the speed of operation. Competitors ecosystems, especially Google, are expanding very fast and increasing market share. There is little time left to establish another ecosystem which will not be marginal. However, traditional way of operation of Microsoft and Nokia is not prepared for very fast change. Their development pace is lagging speed of Android and smart mobile devices. In this respect Windows 8 can be the last chance for building the ecosystem and its fate will be decided quickly.

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